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OFFICE OF WATER RESEARCH AND TECHNOLOGY

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 13, NUMBER 7
APRIL 1, 1980

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A semimonthly publication of the
Office of Water Research and Technology
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The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

TEMPERATURE IN STREAMS OF NEW MEXICO FOR THE PERIOD OCTOBER 1964 TO SEPTEMBER 1969,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. W. Clement.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-299 360, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-140, November 1978. 30 p, 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Water temperature, *Streams, *New Mexico, Equations, Variability, Regression analysis, Regional analysis, *Harmonic equations, Areal description.

Harmonic equations were developed to describe stream temperatures at 144 sites in New Mexico using periodically observed water temperatures collected from October 1964 through September 1969. The harmonic equations explained at least 80 percent of the variability at 70 of the sites. Standard errors of estimate ranged from 1.3 to 5.4 degrees Celsius and averaged 3.1 degrees Celsius. Stream-temperature characteristics are defined in terms of the mean, amplitude, and phase coefficients of the harmonic equations. The characteristics vary widely throughout the State, hence are described areally by regionalized regression equations. Regional equations developed to describe the mean temperature characteristic accounted for at least 84 percent of the variability and had standard errors of estimate less than 13 percent. Only one equation was adequate for describing the amplitude. That equation was for streams having drainage areas less than 2,500 square miles and in the northwestern part of the State. No equation was developed for the phase coefficient. Stream-temperature characteristic profiles are used to describe the trends of the three characteristics along major streams. (Woodard-USGS)
W80-02580

DESIGN OF A NETWORK FOR MONITORING GROUND-WATER QUALITY IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W80-02588

AN EPR STUDY OF THE REDUCTION OF VANADIUM(V) TO VANADIUM(IV) BY FULVIC ACID,
New Hampshire Univ. Durham. Dept. of Chemistry.
S. A. Wilson, and J. H. Weber.
Chemical Geology, Vol 26, p 345-354, 1979. 1 Fig, 1 Tab, 22 Ref. OWRT B-004-NH(1), 14-34-0001-8132.

Descriptors: *Fulvic acids, *Oxidation, *Humic acids, *Redox potential, *Oxidation-reduction potential, *Reduction potential, Ions, Hydrogen ion concentration, *Vanadium, *Metal ions, *Electron paramagnetic resonance, *Soil-derived fulvic acid, *Water-derived fulvic acid, Oxygenated water, Copper binding capacity, Electro-chemical oxidation.

The reduction potential of a soil-derived fulvic acid (SFA) sample is 0.5 V (vs. NHE). The SFA reduction potentials increase with decreasing pH which means tha H+ is consumed when SFA acts as an oxidizing agent. We used this SFA as a reducing agent toward vanadium (V) in an electron paramagnetic resonance (EPR) study. At pH 2 a 10-fold SFA molar excess reduces 50% of a vanadium (V) to a vanadium (IV) species (VO(+2)) within 15 min, but no additional reduction occurs within 4 h. The semiquinone radical in SFA is not involved in the reduction process because its EPR signal intensity does not decrease and because the amount of radical present could account for only 10% of the observed reduction. In a similar experiment at pH 6, only 4.5% soluble VO(+2) is measured by EPR. Most of the VO(+2) formed in the experiment forms EPR-inactive (VOOH)2(+2) and solid VP(OH)2. At pH 2.3 a solution of SFA and vanadium(V) in a 10/1 molar ratio has a reduction potential of 0.57 V (vs. NHE) in agreement with the reduction potential of SFA alone. EPR measurements show that the reduced vanadium product, VO(+2), is partially complexed to SFA at pH 2, but predominantly complexed at pH 4 and 6.
W80-02601

2. WATER CYCLE

2A. General

DETERMINING SOIL HYDROLOGIC CHARACTRISTICS ON A REMOTE FOREST WATERSHED BY CONTINUOUS MONTIORING OF SOILWATER PRESSURES, RAINFALL AND RUNOFF,
Hawaii Univ. at Manoa, Honolulu.
For primary bibliographic entry see Field 2G.
W80-02489

ON THE GENERALIZED KINEMATIC ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W80-02577

USE OF A DIGITALIZED GRID IN THE MAPPING OF THE WATER BALANCE ELEMENTS IN A RIVER BASIN (UTILISATION D'UNE GRILLE D'ALTITUDES DIGITALISEES POUR LA CARTOGRAPHIE D'ELEMENTS DU BILAN HYDRIQUE),
Service Hydrologique National, Bern (Switzerland).
F. de Montmollin, R. Oliver, and F. Zwahlen.
Journal of Hydrology, Vol 44, No 3/4, p 191-209, December 1979. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Water balance, *Watersheds(Basins), *Analytical techniques, *Models studies, Precipitation(Atmospheric), Evaporation, Hydrology, Analysis, Mathematical models, Runoff, Foreign research, Mapping, Spatial distribution, *Switzerland, *Mentue River(Switzerland).

The authors tried to determine the various elements of the water balance in a Swiss middleland typical water basin. To obtain this result, they correlated pluviometry and elevation on a digitalized grid, which elements are 50 sq m. This allows the elaboration of coordinated maps of the kind as proposed by Nordenson. This requires the establishment of precipitation and evaporation maps (the Turc formula or any other can be used), and it also requires a knowledge of the runoff. To illustrate the possibilities of the models constructed, the authors studied the various characteristics of the Mentue, a river located north of Lausanne (Switzerland). (See also W69-05337) (Humphreys-ISWS)
W80-02675

APPLICATION OF A SNOWMELT-RUNOFF MODEL USING LANDSAT DATA,
National Areronautics and Space Administration, Greenblet, MD. Goddard Space Flight Center.
A. Rango, and J. Martinec.
Nordic Hydrology, Vol 10, No 4, p 225-238, 1979. 9 Fig, 19 Ref.

Descriptors: *Snow, *Runoff forecasting, *Wyoming, Model studies, Temperature, Precipitation(Atmospheric), Streamflow, Computers, Hydrology, Snow cover, Snowmelt, Data collections, *Snow-runoff model, LANDSAT.

The snowmelt-runoff model developed by Martinec has been used to simulate daily streamflow on the 228 sq km Dinwoody Creek basin in Wyoming, using snowcover extent from Landsat and conventionally measured temperature and precipitation. For the six-month snowmelt seasons of 1976 and 1974, the simulated seasonal runoff volumes were within 5 and 1%, respectively, of the measured runoff. Also, the daily fluctuations of discharge were simulated to a high degree by the model. Thus far the limiting basin size for applying the model has not been reached, and improvements can be expected if the hydrometeorological data can be obtained from a station inside the basin. Landsat provides an efficient way to obtain the critical snowcover input parameter required by the model. (See also W76-08131) (Lee-ISWS)
W80-02690

2B. Precipitation

AN INVESTIGATION OF POLLUTANT SOURCE STRENGTH-RAINFALL RELATIONSHIPS AT ST. LOUIS,
Illinois State Survey, Urbana. Atmospheric Sciences Section.
D. F. Gatz.
Journal of Applied Meteorology, Vol 18, No 10, p 1245-1251, October 1979. 7 Fig, 1 Tab, 12 Ref. DOE EY-76-S-02-1199.

Descriptors: *Air pollution, *Rainfall, *Correlation analysis, *Cities, Precipitation(Atmospheric), Pollutants, Path of pollutants, Sampling, Data collections, On-site investigations, Data processing, Analytical techniques, Meteorology, *St. Louis(MO).

Speculation concerning effects of pollutants on weather, especially rainfall, has intrigued scientists and laymen alike in recent years. Results from Project METROMEX suggest that rainfall is increased after a moving raincell intersects the urban plume. This paper investigated correlations between rainfall and indices of aerosol pollutant source strength to see whether a causative mechanism might be suggested. Although the correlations between rainfall in certain areas and the source strength of three groups of urban aerosols were significant enough to warrant further investigation, physical relationships did not support an aerosol involvement in the urban rainfall anomaly. (Sims-ISWS)
W80-02494

AN INVESTIGATION OF SURFACE ALBEDO VARIATIONS DURING THE RECENT SAHEL DROUGHT,
Wisconsin Univ., Madison. Space Science and Engineering.
For primary bibliographic entry see Field 7B.
W80-02497

MEASUREMENT OF CONVECTIVE MEAN RAINFALL OVER SMALL AREAS USING HIGH-DENSITY RAINGAGES AND RADAR,
Illinois State Water Survey, Urbana.
P. H. Hildebrand, N. Towery, and M. R. Snell.
Journal of Applied Meteorology, Vol 18, No 10, p 1316-1326, October 1979. 3 Fig, 7 Tab, 10 Ref. Bu.Rec. 14-06-D-7197,NSF ATM76-24236, ENV-01447.

Descriptors: *Rainfall, *Measurement, *Radar, *Rain gages, Analytical techniques, Data processing, Precipitation(Atmospheric), Networks, Rain, Remote sensing, Meteorology.

Techniques of measuring area-mean convective rainfall over small areas (less than 2000 sq km) were investigated using data from several gage-radar rainfall measurement studies. These data suggested that for low gage densities (less than 1 gage per 250-300 sq km) and for some climates (e.g., Illinois), gage-radar area-mean convective rainfall measurements may be more accurate than gage-only measurements. The same result was not supported by data from another climate, suggesting that changes in raincell size and rain evaporation rate may affect the results. Further studies are needed to verify these suggestions. The data indicated that radar adds little to gage measurement of mean areal convective rainfall for gage densities of more than 1 gage per 100-200 sq km. Use of a space-variable gage adjustment of radar data was

seen to be preferable to use of an averaged single adjustment factor, except in cases involving extrapolations of the space-variable adjustment factor. For such cases, e.g., over large lakes or outside of gage networks, use of the averaged single adjustment factor may be preferable. (Sims-ISWS)
W80-02530

ACID PRECIPITATION: MEASUREMENT OF PH AND ACIDITY,
Virginia Univ., Charlottesville, Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W80-02667

ACIDIFICATION AND OTHER CHEMICAL CHANGES IN HALIFAX COUNTY LAKES AFTER 21 YEARS,
Fisheries and Marine Service, Halifax (Nova Scotia).
For primary bibliographic entry see Field 2K.
W80-02668

USE OF A DIGITALIZED GRID IN THE MAPPING OF THE WATER BALANCE ELEMENTS IN A RIVER BASIN (UTILISATION D'UNE GRILLE D'ALTITUDES DIGITALISEES POUR LA CARTOGRAPHIE D'ELEMENTS DU BILAN HYDRIQUE),
Service Hydrologique National, Bern (Switzerland).
For primary bibliographic entry see Field 2A.
W80-02675

OBJECTIVE ANALYSIS OF CONVECTIVE SCALE RAINFALL USING GAGES AND RADAR,
Eddy (Amos), Inc., Norman, OK.
A. Eddy.
Journal of Hydrology, Vol 44, No 1/2, p 125-134, November 1979. 6 Fig, 16 Ref, 1 Append. BUREC 7-07-83-V007.

Descriptors: *Rainfall, *Rainfall disposition, *Mathematical models, *Analytical techniques, *Montana, Networks, Areal, Measurement, Rain gages, Radar, Temporal distribution, Spatial distribution, Storms, On-site investigations, Model studies, Statistical methods, Convective rainfall, Objective analysis.

A functional representation of the morphology and evolution of a mesoscale convective storm was illustrated using HIPLEX radar reflectivities and gage rainfall data observed in Montana. The use of this function in obtaining maximum likelihood estimates of storm-total rainfall and in the optimal deployment of the sensor network was also discussed. It was shown that after four gages per individual storm-total area have been deployed, the marginal benefit realized by adding one more gage is very small if the radar reflectivity data are combined optimally with observations from these gages to produce storm-total rainfall. It was shown that a method exists which allows for optimal sensor placement and an assessment of the relative values of competing network designs. Finally, it follows that if one makes a clear, statistically adequate statement of the central problem, the sampling and analysis procedures can be reduced to a problem in Bayesian decision making and can be expressed in terms of cost/benefit ratios for competing sampling strategies. (Humphreys-ISWS)
W80-02677

REAL-TIME ESTIMATION OF VELOCITY AND COVARIANCE STRUCTURE OF RAINFALL EVENTS USING TELEMETERED RAINGAGE DATA--A COMPARISON OF METHODS,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
E. R. Johnson, and R. L. Bras.
Journal of Hydrology, Vol 44, No 1/2, p 97-123, November 1979. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Rainfall disposition, *Statistical models, *Analytical techniques, *Statistical methods, Rainfall intensity, Stochastic processes, Rainfall, Storms, Methodology, Velocity, Forecasting, Correlation analysis, Sampling, Tracking techniques, Time series analysis, Networks, Analysis, Regression analysis, Data processing.

Short-term rainfall prediction in time and space requires parameter estimation in real time. This paper discussed several methods of using telemetric raingage data to estimate the non-stationary mean and variance of a rainfall event. Similarly, real-time estimation of residual covariance structure and storm velocity was discussed. The performance of the suggested techniques was illustrated with examples. The parameter estimation corresponds to a forecasting model developed by Johnson and Bras. The goal of this article was to inform other researchers of the advantageous and desadvantages of different methodologies for reat-time estimation of ranifall statistical characteristics. The storm counter technique is easy to implenent in real time and is capable of representing significant features of a rainfall event. The method permits handling non-stationarities without major, inflexible, structural assumptions. Testing of several velocity estimators ranging from storm feature tracking to cavariance maximization clearly converged in a regression procedure based on time histories of raingages. The selected estimation procedure proved to be stable and convergent under many conditions. All the parameters estimated and discharged in this paper can be used in real-time forecasting of rainfall. (Humphreys-ISWS)
W80-02678

A DIGITAL RECORDING SYSTEM FOR TIPPING BUCKET RAINGAGES: DESCRIPTION AND FIELD TESTING,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
J. L. Thomas, and F. J. Merceret.
Journal of Applied Meteorology, Vol 18, No 10, p 1376-1379, October 1979. 2 Fig, 1 Tab, 2 Ref.

Descriptors: *Rain gages, *Equipment, *Instrumentation, *Electronic equipment, Design, On-site investigations, On-site data collections, Rainfall, Precipitation(Atmospheric), Measurement, Networks, Meteorology, Electrical engineering.

A system for recording data from a large network of tipping bucket raingages on digital tape cessettes was developed for the Florida Area Cumulus Experiment (FACE). This system is substantially less expensive than those previously available when large members of gages are needed. Field tests during June, July, and August 1978 in South Florida showed the system to be accurate and reliable. (Sims-ISWS)
W80-02680

DEPOSITION OF NUTRIENTS AND MAJOR IONS BY PRECIPITATION IN SOUTH-CENTRAL ONTARIO,
Ontario Ministry of the Environment, Rexdale (Ontario). Limnology and Toxicity Section.
For primary bibliographic entry see Field 2H.
W80-02685

SPATIAL CORRELATIONS OF PRECIPITATION IN NORTHWEST GEORGIA,
Oak Ridge National Lab., TN. Engineering Technology Div.
A. A. N. Patrinos, N. C. J. Chen, and R. L. Miller.
Report No ORNL/TM-6524, September 1978. 42 p, 21 Fig, 1 Tab, 15 Ref. No W-7405-eng-26.

Descriptors: *Precipitation(Atmospheric), *Georgia, *Correlation analysis, *Spatial distribution, Monthly, Topography, Climates, Winds, Distribution patterns, Weather modification, Variability, Analytical techniques, Analysis, Statistical methods, Least squares method, Spatial correlations, Correlation coefficients.

Spatial correlations based on monthly rainfall totals from northwest Georgia for the period 1949-1976 were studied. This work, a part of the Meteorological Effects of Thermal Energy Releases (METER) Program, determines natural variability rainfall trends and assists the field studies of potential precipitation effects of the Bowen Electric Generating Plant near Cartersville, Georgia. The spatial correlation coefficients were investigated with regard to distance between stations, wind direction, and topography. The results indicated a strong dependence of the calculated spatial correlation patterns on the direction of the prevailing storm tracks in the area. (Humphreys-ISWS)
W80-02698

2C. Snow, Ice, and Frost

THE MASS BUDGET OF THE LAMBERT GLACIER DRAINAGE BASIN ANTARCTICA,
Department of Science, Melbourne (Australia). Antarctic Div.
I. Allison.
Journal of Glaciology, Vol 22, No 87, p 223-235, 1979. 4 Fig, 5 Tab, 30 Ref.

Descriptors: *Glaciers, *On-site investigations, *Antarctic, *Drainage, Watersheds(Basins), Ice, On-site data collections, Movement, Geomorphology, Velocity, Measurement, Dimensions, Depth, Analysis, Melt water, Mass budget, Lambert Glacier.

Estimates have been made of the mass budget of the total drainage basin of Lambert Glacier. these show a small but significant positive state of balance for the interior basin (the accumulation area up-stream of the major ice streams), and strongly suggest a positive balance for the Lambert Glacier system (the region of major ice streams, between the Amery Ice Shelf and the interior basin). The total mass flux into the interior basin was estimated as 60 Gt/a. Results were presented from a number of ice movement stations established between 1972 and 1974 around the perimeter of the southern Prince Charles Mountains. These results, together with ice thicknesses from radio echo-sounding in the area, give a total mass outflux through the 2,000 m contour of 30 Gt/a, implying a budget excess of a further 30 Gt/a over the whole interior basin. Results from velocity and ice thickness measurements give a mass discharge through a section near the junction of Lambert Glacier and the Amery Ice Shelf of 11 Gt/a. Losses within the Lambert Glacier system proper account for a further 7 Gt/a and an overall mass excess of 12 Gt/a is estimated for the Lambert Glacier system. This present positive state of balance contrasts with geomorphological evidence from the southern Prince Charles Mountains of a large drop in ice level in recent geological time, and the ice surface in the area may now be building up after a major recession. (Humphreys-ISWS)
W80-02477

IN-SITU MEASUREMENTS OF THE ACTIVATION ENERGY FOR D.C. CONDUCTION IN POLAR ICE,
Wisconsin Univ., Middleton. Geophysical and Polar Research Center.
C. R. Bentley.
Journal of Glaciology, Vol 22, No 87, p 237-246, 1979. 9 Fig, 14 Ref.

Descriptors: *Ice, *On-site tests, *Electrical properties, *Activation energy, Temperature, Measurement, Resistivity, On-site investigations, Testing proceedures, Methodology, Analysis, Analytical techniques, Spatial distribution, *Ross Ice Shelf.

Electrical resistivity measurements were carried out at station J9 on the Ross Ice Shelf where temperature measurements were available to a depth exceeding three-quarters of the thickness of the shelf. As in a previously published study at a point about 30 km up-stream (Bentley, 1977), the apparent resistivities fit well to a model based upon a steady-state ice shelf with zero bottom balance-rate and an apparent activation energy in the solid ice of 0.15 to 0.25 eV, with preference for the lower end of the range. This model also fits the observed temperature data almost perfectly. Causes of resistivity variation with depth other than the temperature, such as impurtiy content, metamorphic hictory, grain size, and crystal orien-

tation, probably do not strongly affect th resistivity depth function. It was concluded that the true activation energy in the solid ice is less than 0.25 eV and perhaps as small as 0.15 eV, although a reduction by a factor of 2 or 3 in the ionic impurity concentration between 50 and 250 m depth cannot be entirely ruled out as a cause of the low apparent temperature effect. (See also W77-08051) (Humphreys-ISWS)
W80-02478

THE EFFECTS OF ICE THICKNESS ON THE EXCHANGE OF SOLAR RADIATION OVER THE POLAR OCEANS,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
T. C. Grenfell.
Journal of Glaciology, Vol 22, No 87, p 305-320, 1979. 9 Fig, 1 Tab, 20 Ref. ONR N00014-76-C-0234.

Descriptors: *Solar radiation, *Albedo, *Absorption, *Transmissivity, *Ice, *Snow, Snowpacks, Sea ice, Polar regions, Wavelengths, Radiation, Energy, Mass transfer, Heat, Temperature, Light, Irradiation, On-site data collections, Model studies, Mathematical models.

Total transmission, absorption, and reflection of solar radiation were determined for bare blue and white ice between 0.02 and 0.8 m in thickness as well as for blue ice covered with 0.01 to 0.4 m of dry packed snow. The calculations were performed at 45 wavelengths between 400 nm and 2,150 nm using a two-stream model to account for the finite thickness of the ice and snow layers. Total radiative energies were found by numerical integration over wavelength. The results were compared with corresponding calculations for optically thick ice of the same types. Albedos increase from about 0.05 for open water to a maximum of 0.9 for thick snow. For 0.8 m blue and white ice, predicted albedos on cloudy days are 0.28 and 0.67, respectively. Under clear skies these albedos decrease by 10 to 30%. Total transmission through thin ice (less than 0.8 m) is from 50% to 300% greater than is predicted by Beer's law depending on ice type and cloud cover. Radiative energy absorption at the surface is independent of thickness, but significant departures from Beer's law of as much as 200% are evident in all cases below a depth of 2.5 mm. A parameterization scheme was presented for incorporating these results into heat- and mass-balance studies. (Sims-ISWS)
W80-02479

IN-SITU ESTIMATES OF THE TENSILE STRENGTH OF SNOW UTILIZING LARGE SAMPLE SIZES,
Norwegian Geotechnical Inst., Oslo.
D. M. McClung.
Journal of Glaciology, Vol 22, No 87, p 321-329, 1979. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Snow, *Tensile strength, *On-site investigations, on-site data collections, Density, Strength, Shear strength, Temperature, Sampling, Data processing, Avalanches, Snowpacks, Mechanical properties.

Experimental procedure and measured estimates of the tensile strength of snow were given by a new method utilizing large sample sizes of naturally deposited snow. Data were presented as a function of average sample density, temperature, loading rate, and snow type. The results showed less scatter in the data than previous in-situ estimates and lower mean strength values as a function of density. The relevance of the data to tensile fracture as observed in slab avalanche release was discussed. (Sims-ISWS)
W80-02480

COMPOSITION, INTERNAL STRUCTURES, AND AN HYPOTHESIS OF FORMATION FOR DRUMLINS, WAUKESHA COUNTY, WISCONSIN, U.S.A.,
Wisconsin Univ.- Madison. Dept. of Geology and Geophysics.
G. R. Whittecar, and D. M. Mickelson.
Journal of Glaciology, Vol 22, No 87, p 357-371, 1979. 8 Fig, 32 Ref.

Descriptors: *Glacial drift, *Wisconsin, *Glaciology, *Geomorphology, Till, On-site investigations, Analysis, Erosion, Maps, Stratigraphy, Land forming, Topography, Gravels, Sands, Shape, Drumlins, Clastic dike.

Late Wisconsin-age drumlins west of Milwaukee are clustered atop uplands bounded by discrete scarps. Gravel operations within the uplands have exposed drumlin cores of undeformed till and outwash beds which are truncated at the sides of the drumlin. In a few areas, clastic dikes, faults, overturned bedding, and shear folds disturb the original layering. The drumlin shapes are blanketed with a basal till 1-3 m thick ('retreat' till) which truncates all internal structures. This till covering cannot be distinguished from the youngest truncated till ('advance' till). Truncation of all of these structures shows that these drumlins are erosional forms carved from pre-existing drift. Apparently, during erosion under compressive flow, some beds became unstable and initiated large-scale movements of material into the drumlin from beneath the drumlin form. Failure and mobilization of the finer grained beds may have been due to increased pore pressures, differing stages of dilatancy, or diff ering bulk densities. A growth into the drumlin from below and rates of erosion of the drumlin form. (Humphreys-ISWS)
W80-02481

THE MECHANICS OF DRUMLIN FORMATION WITH PARTICULAR REFERENCE TO THE CHANGE IN PORE-WATER CONTENT OF THE TILL,
Brock Univ., St. Catharines (Ontario). Dept. of Geography.
J. Menzies.
Journal of Glaciology, Vol 22, No 87, p 373-384, 1979. 6 Fig, 52 Ref.

Descriptors: *Glacial drift, *Pore water, *Glaciology, *Geophysics, Land forming, On-site investigations, Magnetic studies, Till, Topography, Erosion, Ice, Rheology, Geomorphology, Stratigraphy, Analysis, Gravels, Sands, *Scotland, Drumlins.

Most drumlins are composed of till that appears similar in all characteristics to non-drumlin till. Evidence, however, in the form of till layer sequences and from palaeo-magnetic Koenigsberger ratios indicate that drumlin till may have a slightly higher pore-water content at the time of lodgement than non-drumlin till. In order that deposited till remains at the ice-glacier-bed interface to initiate drumlin formation, it must undergo rapid geotechnical changes whereby its pore-water content is dissipated thereby increasing the shear strength of the till. Two mechanisms of pore-water removal are possible. First, pore water may be removed from localized patches within a mobile layer of till at the ice-glacier-bed interface, thus creating nuclei of higher strength till around which deforming till may adhere. Second, removal of water initially from the thin water film at the base of a glacier may result in increased pressure melting of the ice leading to till melt-out and subsequent loss of pore water from the deposited till. The loss of water at the glacier bed may be either via permeable subglacial deposits or bedrock, or bedrock, or within subglacial depressions. (Humphreys-ISWS)
W80-02482

MERCURY-IN-GLASS THERMOMETERS FOR PRECISE TEMPERATURE MEASUREMENTS NEAR O C,
Alaska Univ., Faribanks. Geophysical Inst.
T. E. Osterkamp.
Journal of Glaciology, Vol 22, No 87, p 385-388, 1979. 1 Fig, 1 Tab, 3 Ref. NSF GA-30748.

Descriptors: *Thermometers, *Temperature, *Measurement, *Equipment, Instrumentation, Calibrations, Laboratory tests, On-site investigations, On-site data collections, Glaciers, Ice, Snow, Glaciology.

Experience with the calibration and field use of mercury-in-glass calorimeter thermometers provided an indication of the accuracy attainable and the necessary corrections to obtain that accuracy. Secular changes as large as 57 mK were observed during the first three years of thermometer use. Light physical tapping was found to reduce the thermometer readings by 3-6 mK. Corrections for variations in the external and internal bulb pressure and care to avoid parallax were necessary to obtain the best accuracy in field measurements. The best accuracy obtainable with these thermometers for temperature measurements near O C was approximately plus or minus 4 mK for laboratory measurements and plus or minus 5 mK for field measurements. (Sims-ISWS)
W80-02483

A SYSTEM FOR ACCURATE TEMPERATURE CONTROL OF SMALL FLUID BATHS,
Department of Science, Melbourne (Australia). Antarctic Div.
V. I. Morgan.
Journal of Glaciology, Vol 22, No 87, p 389-391, 1979. 2 Fig, 2 Ref.

Descriptors: *Temperature, *Temperature control, *Equipment, *Instrumentation, Ice, Laboratory tests, Electronic equipment, Heat, Heating, Control, Laboratory equipment.

A temperature controller was described which uses a thermistor sensor and electrical heating to maintain the temperature of a small bath of fluid to within a few milli-degrees. (Sims-ISWS)
W80-02484

THE FLOW OF ICE OVER A TILL BED,
Queensland Univ., Brisbane (Australia). Dept. of Mathematics.
A. S. Jones.
Journal of Glaciology, Vol 22, No 87, p 393-395, 1979. 2 Fig, 3 Ref.

Descriptors: *Glaciers, *Ice, *Model studies, Mathematical models, Equations, Till, Soils, Glacial soils, Glaciology, Glacier surging.

This paper considered the contribution made to overall glacier flow by deformation of an unlithified bed. The flow pattern in deforming till beneath a glacier was determined for the case of a uniform ice slab resting on a uniform thick till bed. The results obtained showed that, once the till is saturated, very little surplus water is needed to produce high velocities in the till near the ice-till interface, the interface velocity varying as the 5/2 power of the surplus water concentration. This sensitivity to water content suggests that this may be a mechanism inducing glacier surging. (Sims-ISWS)
W80-02485

PATTERN RECOGNITION ANALYSIS OF SNOWDRIFTS,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and T. J. Jackson.
Nordic Hydrology, Vol 10, No 4, p 251-260, 1979. 4 Fig, 2 Tab, 22 Ref.

Descriptors: *Snowpacks, *Demonstration watersheds, *Idaho, *Distribution patterns, Snow cover, Watersheds(Basins), Spatial distribution, Snow management, Snow surveys, Remote sensing, Aerial photography, On-site investigations, Methodology, Analytical techniques, Analysis, Topography, *Owyhee Mountains(ID).

Terrain features and prevailing wind patterns play a dominant role in how snow is accumulated. Research was conducted to determine the location of snowdrifts on a 0.41 sq km subbasin of the Reynolds Creek Experimental Watershed located in the Owyhee Mountains in southwestern Idaho. Snow depths at maximum accumulation were determined on a 7.6 m grid using aerial photography. The terrain variables used in the analysis were ground slope, ground aspect, elevation, distance from the top of the ridge in the direction of the

prevailing wind, and the difference in elevation between the top of the ridge and the point. A pattern recognition technique called cluster analysis was used to determine the best terrain variables for locating snowdrifts. The analysis indicated that slope and aspect were the best variables. Discriminant functions using these variables and the prevailing wind were developed to predict the location of snowdrifts. The functions were tested on a 16.7 sq km area and satisfactorily predicted the location of snowdrifts. Such relationships for predicting the location in snow drifts will enable better management of the vast amounts of water stored in snow drifts which is needed in making management decisions for irrigation, stock water, municipal water supplies, hydroelectric power generation, recreation, navigation, and pollution control. (Humphreys-ISWS)
W80-02688

APPLICATION OF A SNOWMELT-RUNOFF MODEL USING LANDSAT DATA,
National Areronautics and Space Administration, Greenblet, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2A.
W80-02690

2D. Evaporation and Transpiration

USE OF A DIGITALIZED GRID IN THE MAPPING OF THE WATER BALANCE ELEMENTS IN A RIVER BASIN (UTILISATION D'UNE GRILLE D'ALTITUDES DIGITALISEES POUR LA CARTOGRAPHIE D'ELEMENTS DU BILAN HYDRIQUE),
Service Hydrologique National, Bern (Switzerland).
For primary bibliographic entry see Field 2A.
W80-02675

A COMPARISON OF SOME METHODS FOR ESTIMATION OF POTENTIAL EVAPORATION,
Royal Veterinary and Agricultural Coll. Copenhagen (Denmark). Hydrotechnical Lab.
K. J. Kristensen.
Nordic Hydrology, Vol 10, No 4, p 239-250, 1979. 10 Fig, 1 Tab, 16 Ref.

Descriptors: *Evaporation, *On-site tests, *Evapotranspiration, *On-site data collections, On-site investigations, Instrumentation, Evaporative pans, Measurement, Evaporimeters, Water loss, Grasses, Barley, Sugar beets, Foreign research, *Denmark, Winter wheat.

In Denamrk, a screened sunk iron pan has been used as a standard since 1956. This standard pan and other methods for estimating potential evaporation have been compared during a 15-year period. The measurements reported were carried out at the Climate and Water Balance Station of the Royal Veterinary and Agricultural University, Denmark. The station is situated about 20 km west of Copenhagen. The installations are placed in or above a level area covered by short grass. The area was irrigated whenever needed in order to avoid or to reduce oasis effect caused by insufficient evaporation from areas surrounding the climate station. The results presented indicate that under climatic conditions as in Denmark, the potential evaporative demand of a vegetation can be estimated reasonably well by sunk iron pans or by the Penman calculating method. The sunk pan evaporation is proportional to maximum crop evaporation and to the calculated evaporation, provided the thermal convection of the water in the tank is prevented and that a screen, when used, is not impeding the ventilation of the water surface. The maximum evaporation from a free water surface (12 sq m) is about 10% greater than the potential evaporation from grass. The maximum actual evapotranspiration from some agricultural crops (e.g., barley and sugar beets) exceeds the potential evapotranspiration from grass by about 10%. (Humphreys-ISWS)
W80-02689

COMPARISON AND COMBINATION OF TWO RECENT PROPOSALS FOR A GENERALIZED PENMAN EQUATION,
Dar es Salaam Univ., Tanzania. Dept. of Physics.
C. J. Stigter.
Quarterly Journal of the Royal Meteorological Society, Vol 105, No 446, p 1071-1073, October 1979. 1 Tab, 8 Ref.

Descriptors: *Evaporation, *Equations, *Agricultural runoff, Hydrologic data, Hydrology, Water management(Applied), Calibrations, Lysimeters, Vegetation, Wind velocity, Roughness(Hydraulic), *Penman equation, *Agricultural water management, Hydrological water management, Aerodynamical terms, Grass lysimetry, Average wind speed.

The importance of Penman's evaporation equation in agricultural and hydrological water management was shown by two proposals for its generalization. The 1977 proposal, based on experimental work done in 1977 and on the theoretical study by Thom and Oliver in 1977, suggests that the experimental studies and the theoretical work be combined in order to generalize the equation in the interests of greater physical realism and higher accuracy. In both cases the calibration problem remained. The experimental study used only lysimeter experiments and crop coefficients based on field studies of soil and water status. The theoretical study relied on catchment area water balance studies to contribute to the solution of evaporation. (See also W77-09953) (Roberts-ISWS)
W80-02699

2E. Streamflow and Runoff

DETERMINING SOIL HYDROLOGIC CHARACTRISTICS ON A REMOTE FOREST WATERSHED BY CONTINUOUS MONTIORING OF SOILWATER PRESSURES, RAINFALL AND RUNOFF,
Hawaii Univ. at Manoa, Honolulu.
For primary bibliographic entry see Field 2G.
W80-02489

SECONDARY FLOW AND SHEAR STRESS AT RIVER BENDS,
Institute of Hydrology, Wallingford (England).
J. C. Bathurst, C. R. Thorne, and R. D. Hey.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 105, No HY10, Proceedings Paper 14906, p 1277-1295, October 1979. 9 Fig, 3 Tab, 42 Ref, 1 Append.

Descriptors: *Shear stress, *River beds, *Rivers, Hydraulics, Bank stability, Velocity, Currents(Water), Turbulence, Circulation, Open channel flow, Curves, On-site investigations, *Secondary flow, *Velocity distributions, *River bends, *Curvature.

Field measurements were presented to illustrate the pattern of secondary circulation at river bends, the effect of the circulation on boundary shear stress distribution, and the way in which that effect changes with discharge. The field results showed that, in addition to the classical main cell, there can be a small cell of opposite circulation close to the outer bank provided the bank is steep. The circulation distorts the primary isovel pattern and thereby affects the positions and relative magnitudes of the boundary shear stress peaks associated with regions of downwelling and high velocity. Secondary circulation appears to be weakest at low and high discharges and to be strongest, with its greatest effect on the shear stress distribution, at medium discharges. Generally, the distribution of shear stress at a section becomes more uniform as discharge increases and at high discharges is determined mainly by primary flow effects. (Adams-ISWS)
W80-02566

ON THE GENERALIZED KINEMATIC ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
K. Beven.
Water Resources Research, Vol 15, No 5, p 1238-1242, October 1979. 5 Fig, 8 Ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Small watersheds, Hydrology, Runoff, Model studies, Velocity, Discharge(Water), Channels, Flow, Watersheds(Basins), *England, *Kinematic routing method, Steep rough upland channels, Channel networks, Small upland watersheds.

Field measurements suggest that the relationship between velocity and discharge in steep rough upland channels may be nonlinear at low-flow stages but approximately linear at high-flow stages. This paper described a generalized kinematic channel network routing model which can allow a flow relationship that describes both high- and low-flow characteristics. The model was applied to the channel network of the Institute of Hydrology's River Severn experimental catchment and, for this specific application, proved to be equivalent to a linear model based on a constant kinematic flow velocity. A strategy for choosing and applying a flow routing model for use in small catchments was suggested. (Lee-ISWS)
W80-02577

FLOW ROUTING IN THE SUSQUEHANNA RIVER BASIN: PART III - ROUTING RESERVOIR RELEASES IN THE TIOGA AND CHEMUNG RIVERS SYSTEM, PENNSYLVANIA AND NEW YORK,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 6A.
W80-02586

RANGE OF INDEPENDENT MIXTURE MODELS IN HYDROLOGY,
Technical Univ. of Istanbul (Turkey), Dept. of Hydraulics and Water Power.
Z. Sen.
Water Resources Research, Vol 15, No 5, p 1213-1216, October 1979. 6 Fig, 12 Ref.

Descriptors: *Model studies, *Hydrology, *Stochastic processes, Droughts, Reservoirs, Statistical models, Equations, Effects, *Independent mixture models, Inflow sequence.

A general formula relating low order statistics of surplus and deficit to range of cumulative departures was proposed on the basis of the independent mixture models. By means of derived expressions, the effects of both drought duration and intensity on the range were documented, leading to the conclusion that even if the successive observations are independent, increases in drought duration and intensity cause the range to increase. (Lee-ISWS)
W80-02587

MATHEMATICAL DERIVATION OF LINEAR AND NONLINEAR RUNOFF KERNELS,
Tokyo Inst. of Tech. (Japan), Dept. of Civil Engineering.
M. Hino, and K Nadaoka.
Water Resources Research, Vol 15, No 4, p 918-928, August 1979. 11 Fig, 18 Ref.

Descriptors: *Unit hydrographs, *Mathematical models, *Analytical techniques, Parametric hydrology, Synthetic hydrology, Simulation analysis, Mathematics, Rainfall-runoff relationships, Model studies, *Runoff kernels, Basin response, Nonlinear kernels.

From a viewpoint of overall grasp of response characteristics of a basin to rainfall, an integral form of expression, such as the unit hydrograph, the Volterra series, and the Wiener series, is superior to differential equation type expressions. However, hitherto, response or runoff kernels have been derived from empirical data or at the most from numerical simulation data. In this paper, the runoff was represented by the Wiener-Hermite orthogonal functional expansion. By application of the Galerkin technique, a set of ordinary nonlinear differential equations for the expansion coefficients of kernal functions was derived from the basic equation of motion. The differential equations were solved by the Runge-Kutta-Gill scheme to obtain

the runoff kernels. Various features of the theoretical linear and nonlinear runoff kernels thus derived compared well with the empirical ones. The characteristics such as small humps and shallow ditches in the nonlinear kernel derived previously from empirical data were shown to be neither insignificant errors inherent in field data nor interactions between the components other than surface runoff but were a theoretical necessity. (Singh-ISWS)
W80-02655

CRITICAL EXAMINATION OF THE MUSKINGUM METHOD,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Civil Engineering.
M. A. Gill.
Nordic Hydrology, Vol 10, No 4, p 261-270, 1979. 2 Fig, 12 Ref.

Descriptors: *Flood routing, *Hydrology, *Rivers, Channels, Time lag, River beds, Equations, Mathematical studies, Waves(Water), Discharge(Water), Inflow, Kinematic wave approach, Kinematic wave analogy.

The Muskingum method of flood routing was critically reviewed. The kinematic wave approach was used to evaluate the Muskingum parameters. The linear hydrological method of using the Muskingum equation leads to conclusions which are comparable with those deducible from the linear kinematic wave theory. The linear kinematic approach, however, is somewhat delimited in its scope, because for $X = 0.5$, it always predicts a translatory wave, which may not actually be the case. The hydrological method is free from this fault. The concept of time lag was emphasized, particularly for initial values of time. Conventionally, it was assumed that the inflow and outflow hydrographs start changing from initial steady flow condition simultaneously. It was emphasized that this fact is not always the case. The outflow hydrograph will only start changing after the lapse of a certain time from the moment when the inflow hydrograph starts changing. The use of the time lag concept eliminated the initial appreciably reduced or sometimes even negative values of the routed outflow hydrograph. (Lee-ISWS)
W80-02687

APPLICATION OF A SNOWMELT-RUNOFF MODEL USING LANDSAT DATA,
National Areronautics and Space Administration, Greenblet, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2A.
W80-02690

SWMM APPLICATION TO COMBINED SEWERAGE IN NEW HAVEN,
Cardinal Engineering Associates, Meriden, CT.
J. A. Cermola, S. DeCarli, D. R. Sachdev, and H. M. El-Baroudi.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 105, No EE6, Proceedings Paper 15042, p 1035-1048, December 1979. 6 Fig, 6 Tab, 9 Ref, 1 Append.

Descriptors: *Storm runoff, *Urban runoff, *Combined sewers, *Model studies, Mathematical models, Computer models, Calibrations, Runoff, Sewers, Drainage, Precipitation(Atmospheric), Rainfall, Srorms, Design storms, Watersheds(Basins), Pollutants, Water pollution, Overflow, Water quality, Biochemical oxygen demand, Suspended solids, Water management(Applied), *New Haven(CT).

Storm Water management Model (SWMM) of EPA was calibrated to predict runoff flows in the central portion of the city of New Haven, Connecticut. The study area is served by combined sewers and overflow structures to divert excess wet weather flow into the adjacent receiving waters. For application of SWMM, the project area was divided into 23 subcatchments, and two of them were selected for model calibration. During storm events, the rainfall hyetographs, the runoff hydrographs, and combined sewage quality parameters were measured in each of the two subcatchments. Using these data in SWMM, calibration and verification of flow quantities were accomplished successfully. However, problems were encountered in the quality calibration. The calibrated model (quantity portion only) was subsequently used to predict runoff flows for the design storm in each of the 23 subcatchments. A two-year storm was selected as design storm from the available 35 years of rainfall record. Literature values of BOD and SS were used to predict wet weather waste loads. (Sims-ISWS)
W80-02694

CALCULATION OF STRONGLY CURVED OPEN CHANNEL FLOW,
Karlsruhe Univ. (Germany, F.R.).
M. A. Leschziner, and W. Rodi.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 105, No HY10, Proceedings Paper 14927, p 1297-1314, October 1979. 8 Fig, 21 Ref, 2 Append.

Descriptors: *Turbulence, *Open channel flow, *Hydraulics, Velocity, Currents(Water), Shear stress, Circulation, Mathematical models, Curves, Model studies, *Secondary flow, *Velocity distributions, *River bends, *Finite difference analysis, Curvature.

The paper described the application of a finite-difference calculation procedure to the problem of simulating the three-dimensional, turbulent flow in a strongly curved, open, 180 deg bend with straight inlet and outlet reaches. The configuration can be considered to represent an element of a model meander, and the work presented here forms an important stage in efforts to simulate the flow in successive reverse-curvature bends. No restrictions other than the absence of flow separation and hydraulic jumps are imposed. Full account was taken of non-linear fluid-inertia and of turbulent diffusion terms. Effects of turbulence were represented by an eddy viscosity related to two parameters--the turbulent kinetic energy and its rate of dissipation--for which related differential transport equations were solved. Predictions were presented for the transverse surface slope and velocity field in a configuration experimentally examined by Rozovskii. Agreement between predictions and experimental data was judged to be satisfactory on all major flow phenomena. (Adams-ISWS)
W80-02696

2F. Groundwater

THE EFFECT OF HYDROGEOLOGY ON VARIATIONS IN THE ELECTRICAL CONDUCTIVITY OF GROUNDWATER FLUCTUATIONS,
Andhra Univ., Waltair (India). Dept. of Geophysics.
V. V. J. Sarma, N. V. B. S. S. Prasad, and P. R. Prasad.
Journal of Hydrology, Vol 44, No 1/2, p 81-87, November 1979. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Hydrogeology, *Groundwater, *Water level fluctuations, *Electrical conductance, *Fissures(Geologic), Geologic control, Conductivity, Sampling, Water wells, Dissolved solids, Ion exchange, Weathering, Water table, Clays, *India.

A regular monthly inventory of water level height and water quality of about 100 wells along the coast from Visakhapatnam to Bhimilipatnam was made for a 13-month period during 1974-1975. The electrical conductivity of the waters was found to vary with seasonal water level fluctuations. However, it was observed that this variation has two different patterns. The first pattern is that when the water level lowers, the electrical conductivity decreases; and the second pattern is that when the water level lowers, the electrical conductivity increases. The geological environment is the same for both cases, but the two patterns result from water table fluctuations in two different hydrogeological zones. (Visocky-ISWS)
W80-02412

FRACTURE-CONTROLLED GROUND-WATER CIRCULATION AND WELL SITING IN THE VICINITY OF LARAMIE, WYOMING,
Wyoming Univ., Laramie. Dept. of Geology.
P. W. Huntoon, and D. A. Lundy.
Ground Water, Vol 17, No 5, p 463-469, September-October 1979. 5 Fig, 2 Tab, 15 Ref. OWRT A-024-WYO(2), OWRT 14-34-0001-7108.

Descriptors: *Groundwater, *Aquifers, *Wyoming, Groundwater movement, Artesian aquifers, Wells, Sites, Water wells, Fractures(Geologic), Fracture permeability, Transmissivity, Geology, Springs, Limestones, Circulation, Water circulation, Water quality, Water resources.

The artesian Casper aquifer, comprised of 700 ft of interbedded limestones and sandstones, currently supplies 70% (3.5 Mgal/d) of the municipal-water needs of Laramie, Wyoming. Large transmissivities occur in fracture zones associated with faults and folds in the area, and water discharges from several springs localized along these structures. Transmissivities in fracture zones are 100 times greater than those in unfractured parts of the aquifer. The overlying Satanka Shale is a regional confining unit even in most areas of fracturing, and is a source of poor quality groundwater. Prospecting for new groundwater supplies near Laramie involves mapping the tectonic structures and drilling into them once they are identified. (Sims-ISWS)
W80-02414

AVAILABILITY OF GROUND WATER ON FEDERAL LAND NEAR THE AK-CHIN INDIAN RESERVATION ARIZONA--A RECONNAISSANCE STUDY,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-02581

MAPS SHOWING GROUND-WATER CONDITIONS IN THE KANAB AREA, COCONINO AND MOHAVE COUNTIES, ARIZONA--1976,
Geological survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-02589

SELECTED WELL INVENTORY AND CHEMICAL ANALYSIS OF GROUND WATER, PARTS OF MISSOULA AND POWELL COUNTIES, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
K. R. Wilke.
Availability: OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, microfiche $5.50, paper copy $3.25. Geological Survey open-file report 79-1491, September 1979. 4 p, 2 Fig, 2 Tab.

Descriptors: *Water wells, *Well data, *Water levels, *Water quality, *Groundwater, Chemical analysis, Water utilization, Montana, *Well inventory, *Missoula County(MT), *Powell County(MT).

Ground-water data collected in 1975-76 in the Swan and Avon valleys of western Montana and in 1978 in southwestern Missoula are presented in two tables. Table 1 is an inventory of 146 selected wells and table 2 lists chemical analyses of ground water from 52 wells. (Woodard-USGS)
W80-02590

AN IMPROVED MONTE CARLO PROCEDURE FOR THE SOLUTION OF THE STEADY-STATE, TWO-DIMENSIONAL DIFFUSION EQUATION WITH APPLICATION TO FLOW THROUGH POROUS MEDIA,
Kansas Univ., Lawrence. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 6A.
W80-02607

HYDROGEOLOGY OF SEDIMENTARY ROCKS: PART I - CARBONATES,

Geo-Environ, Ltd., Toronto (Ontario).
B. Whitehead.
Canadian Water Well, Vol 5, No 4, p 26-29, November, 1979. 4 Fig.

Descriptors: *Karst hydrology, *Carbonate rocks, Sedimentary rocks, Limestones, Dolmite, Groundwater, Aquifer characteristics, Deposition, Porosity, Water yield, Fracture permeability, Hydrogeology.

Shale, carbonates, and sandstone are the sedimentary rocks that are important sources of groundwater. The Hydrogeologic characteristics of these rocks are affected by texture, mineral composition and pre-and post-depositional environments. The main carbonate sediments are limestone and dolomite. Compaction reduces porosity to less than 20%. Dolomitization may increase porosity by as much as 13%. Surface weathering of carbonate rock results in solutioning along fractures which permits the development of substantial quantities of water in the upper 10 ft. of rock. However, care should be taken to prevent the entrance of wastes into the ground water through solution channels. Water levels in carbonate aquifers can fluctuate considerably which may have a drastic effect on well yield. Well yield can be improved by development techniques such as controlled blasting, hydraulic fracturing, and acidizing. (Purdin-NWWA)
W80-02661

GROUNDWATER QUALITY NEAR AN UNDERGROUND COAL GASIFICATION EXPERIMENT,
California Univ., Livermore. Lawrence Livermore Lab.
J. H. Campbell, F. T. Wang, S. W. Mead, and J. F. Busby.
Journal of hydrology, Vol 44, No 3/4, p 241-266, December 1979. 13 Fig, 8 Tab, 15 Ref.

Descriptors: *Groundwater, *Water quality, *Coal mines, *Gases, *Wyoming, Sampling, Wells, Organic matter, Phenols, Wastes, Water pollution, On-site investigations, Methane, Electrical conductance, Coal gasification.

Groundwater sampling and analysis have been carried out at the site of an underground coal gasification experiment conducted near Gillette, Wyoming. Water from more than 12 wells in the vicinity of the experiment was sampled before, during, and up to 25 months following gasification. Water samples were analyzed for a variety of characteristics, including the presence of 70 inorganic species, phenolic materials, and volatile and semi-volatile organics. A greatly increased concentration of organic materials, particularly phenols, just outside the burn boundary and a variety of inorganic species issuing from within the residual ash bed were found. All detectable contaminants rapidly decreased in concentration with distance, although above-background levels of some materials were detected 30 m from the burn zone within three days of the gasification. Several important contaminants showed a large decrease in concentration with time, probably due to adsorption. The results suggested a simple physical picture of the development of groundwater pollution near an underground coal gasifier. (Visocky-ISWS)
W80-02674

THE TRANSIENT WATER TABLE BENEATH A LEAKING CANAL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
D. E. Smiles, and J. H. Knight.
Journal of Hydrology, Vol 44, No 1/2, p 149-162, November 1979. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Groundwater, *Infiltration, *Unsteady flow, *Analytical techniques, Water table, Porous media, Fluid mechanics, Hydrodynamics, Model studies, Leakage, Equations, Differential equatons, Leaky canals.

An approximate but accurate analysis of the evolution of the groundwater table beneath a leaking irrigation canal was described. The analysis treated the canal as a constant-rate line source and used the notion of the flux-concentration relation of Philip. The method was not restricted to initially dry aquifers. Extension of the analysis to layered soils was discussed. (Adams-ISWS)
W80-02676

HYDROGEOCHEMISTRY OF THE CORSAGLIA VALLEY, MARITIME ALPS, PIEDMONT, ITALY,
Turin Univ (Italy). Ist. di Geologia e Paleontologia.
G. C. Bortolami, B. Ricci, G. F. Susella, and G. M. Zuppi.
Journal of Hydrology, Vol 44, No 1/2, p 57-59, November 1979. 12 Fig, 3 Tab, 15 Ref.

Descriptors: *Geochemistry, *Hydrogeology, *Karst hydrology, *Crystalline rocks, *Fracture permeability, Carbonate rocks, Groundwater movement, Base flow, Geologic control, Water chemistry, Limestones, Flow system, Permeability, Watersheds(Basins), Rain water, Valleys, Sampling, Deuterium, Oxygen isotopes, Precipitation(Atmospheric), Chlorides, Sulfates, *Italy, *Alps.

This study presented the results of hydrogeochemical investigations in the drainage basin of the Corsaglia Valley (Piedmont, Italy). This small catchment area (110 sq km) is located on the northern side of the Maritime Alps and shows different lithologic types (crystalline and carbonate rocks). It is possible to find zones with important karstic systems adjacent to very impermeable rocks in which local groundwater flow can occur through fracture systems. Because of the complex geology, all karstic systems and their respective catchment areas are independent. Thirty-six sampling stations were selected throughout the basin, and sampling was carried out during two different climatic periods: during April 1976 and October 1974. The problems considered in this investigation were: (1) chemical compositons of rain waters as a function of geographic locations and climatic conditions; (2) crystalline rock hydro-geochemistry; (3) rock-water interactions in karstic systems; and (4) water flow in carbonate rocks and related fluctuations of chemical contents. Two principal flow systems can be recognized for the karst: the first, deep and chemically homogeneous, represents the base flow; the second, shallow and characterized by rapid flow, has a low and variable salt content. In the crystalline rocks only one flow system can be recognized: it is characterized by rapid flow and a remarkable variation of the ionic species. (Visocky-ISWS)
W80-02679

2G. Water In Soils

DETERMINING SOIL HYDROLOGIC CHARACTRISTICS ON A REMOTE FOREST WATERSHED BY CONTINUOUS MONTIORING OF SOILWATER PRESSURES, RAINFALL AND RUNOFF,
Hawaii Univ. at Manoa, Honolulu.
L. R. Ahuja, and S. A. El-Swaify.
Journal of Hydrology, Vol 44, No 1/2, p 135-147, November 1979. 10 Fig, 1 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationships, *Hawaii, *Watersheds(Basins), *Forest watersheds, Forestry, Soil-water-plant relationships, Rainfall, Runoff, Hydrology, Hydraulic conductivities, *Soil-water pressures, Soil hydrologic characteristics, Richard's equation.

Continuous monitoring of soil water pressures, rainfall, and runoff under natural conditions was tested as a technique for determinig soil hydrologic characteristics of a remote forest watershed plot. A completely battery-powered (and thus portable) pressure transducer-scanner-recorder system was assembled for monitoring of soil water pressures in the tensiometric range. Measurements during several heavy rainstorms incorporating a period of steady infiltration rate were utilized to determine the saturated (or near-saturated, because of entrapped air) hydraulic conductivities of different soil horizons. Unsaturated hydraulic conductivities were obtained as usual from drainage data. Use of the monitored soil water pressure data under natural conditions in conjunction with the measured unsaturated soil properties to calculate deep percolation, infiltration-minus-evapotranspiration, and evapotranspiration was illustrated. (Lee-ISWS)
W80-02489

2H. Lakes

SEDIMENTATION AND USEFUL LIFE OF RESERVOIRS,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Civil Engineering.
M. A. Gill.
Journal of Hydrology, Vol 44, No 1/2, p 89-95, November 1979. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Sedimentation, *Reservoirs, *Trap efficiency, Reservoir silting, Hydrology, Equations, Mathematical studies, Effects, Sands, Silts, Silting, *Reservoir life, Brune's curves.

Analytical solutions were presented for calculating sedimentation and useful life of reservoirs using the trap efficiency relationships. Empirical equations were fitted to Brune's trap efficiency curves, and these equations were combined with the differential equation of the rate of reservoir sedimentation to produce the final solution. The final equations are simple and can readily be used in design calculations. (Lee-ISWS)
W80-02468

LIMNOLOGY OF TAYLOR CREEK IMPOUNDMENT WITH REFERENCE TO OTHER WATER BODIES IN UPPER ST. JOHNS RIVER BASIN, FLORIDA,
Geological Survey, Reston, VA. Water Resources Div., and Geological Survey, Tallahassee, FL. Water Resources Div.
D. A. Goolsby, and B. F. McPherson.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A073 460, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-91, 1978. 95 p, 31 Fig, 21 Tab, 30 Ref.

Descriptors: *Water quality, *Limnology, *Impoundments, Reservoirs, Nutrients, Eutrophication, Thermocline, Hypolimnion, Organic matter, Phytoplankton, Water analysis, Evaluation, Florida, *Blue Cypress Lake(Fla), Upper St. Johns River.

Taylor Creek Impoundment, on the western part of the upper St. Johns basin, Fla., provides flood control and flow regulation. The 4,000-acre impoundment was first filled in 1969. The water was of relatively poor quality during the first three years of its existence, 1970-72. The impoundment is deep enough for thermal stratification, and a thermocline usually develops at 8 to 10 feet. During 1970-72 the hypolimnion remained anaerobic for more than six months. The poor water quality is attributed to the decomposition of flooded vegetation, of soil organic matter, and to heavy growths of phytoplankton and duckweed stimulated by an abundant supply of nutrients. Since 1972, the quality of the water has improved because of flushing of the impoundment and depletion of leachable nutrients and soil organic matter. The water is now similar in quality to that of nearby Wolf and Jane Green Creeks. Large releases of water may produce velocities great enough to resuspend bottom sediments several miles downstream where Taylor Creek flows into Lake Poinsett. (Woodard-USGS)
W80-02583

RANGE OF INDEPENDENT MIXTURE MODELS IN HYDROLOGY,
Technical Univ. of Istanbul (Turkey), Dept. of Hydraulics and Water Power.
For primary bibliographic entry see Field 2E.
W80-02587

WATER AND NUTRIENT TRANSPORT VIA GROUNDWATER FROM WARD VALLEY INTO LAKE TAHOE,
California Univ., Davis. Inst. of Ecology.
S. L. Loeb, and C. R. Goldman.
Limnology and Oceanography, Vol 24, No 6, p 1146-1154, November 1979. 6 Fig, 2 Tab, 23 Ref. NSF GI-22.

Descriptors: *Groundwater, *Groundwater movement, *Lakes, *Nutrients, Water chemistry, Aquifers, Pumping, Transmissivity, Sampling, Geology, Nitrogen, Nitrates, Phosphorus, Dissolved oxygen, Hydrogen ion concentration, Water temperature, Water levels, Water pollution, Water pollution sources, Pollutants, Path of pollutants, *Lake Tahoe, *Ward Valley(CA).

The amount of groundwater transported from the Ward Valley watershed into Lake Tahoe during the 1975 water year was 4,100,000 cu m. This was 16% of the water volume carried by Ward Creek and 10% of the total precipitation within the watershed during the same period. Of the total nutrient loading of Lake Tahoe from the Ward Valley watershed, goundwater contributed 49% of the total nitrate-nitrogen and 44% of the total soluble phosphorus loads. Groundwater may be a significant souce of water and dissolved nutrientw for Lake Tahoe, particularly in the littoral zone. (Sims-ISWS)
W80-02669

NUTRIENT DEPENDENCE OF PRIMARY PRODUCTIVITY IN LAKES,
Minnesota Univ., Minneapolis. Limnological Research Center.
V. H. Smith.
Limnology and Oceanography, Vol 24, No 6, p 1051-1064, November 1979. 7 Fig, 1 Tab, 68 Ref.

Descriptors: *Nutrients, *Primary productivity, *Lakes, Photosynthesis, Chlorophyll, Water chemistry, Turbidity, Nitrogen, Phosphorus, Sampling, Chemical analysis, Analytical techniques, Correlation analysis, Oxygen, Dissolved oxygen, Hypolimnion, Limnology.

An analysis of growing season measurements of daily primary productivity, chlorophyll, water chemistry, and transparency form 58 north temperate lakes showed a strong correlation between volumetric rates of photosynthesis, chlorophyll, and nutrients. Mean daily rates of photosynthesis per unit volume euphotic zone were correlated with mean chlorophyll concentration (r sq = 0.80). The mean daily rate of photosynthesis at optimal depth was highly correlated with mean total P(r sq = 0.95), and with mean total N(r sq = 0.91). In contrast, integral rates of photosynthesis were linked less tightly to nutrient concentration because of their simultaneous dependence on transparency. The Dillon-Rigler phosphorus loading model was extended to predict volumetric rates of photosynthesis in lakes where the N:P balance indicates control by phosphorus (N:P greater than 13). (Sims-ISWS)
W80-02671

PARTICULATE METALS IN WATERS OF A TYPICAL IRRIGATION RIVER: THE RIVER SAKURAGAWA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W80-02683

DYNAMICS OF DISSOLVED OXYGEN IN A HYPEREUTROPHIC LAKE: LAKE KASUMIGAURA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
K. Kuroiwa, Y. Ogawa, H. Seki, and S. Ichimura.
Water, Air, and Soil Pollution, Vol 12, No 2, p 255-264, August 1979. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Dissolved oxygen, *Lakes, *Eutrophication, *On-site tests, On-site investigations, Oxygen requirements, Dystrophy, Chlorophyll, Respiration, Productivity, Limnology, Distribution, Foreign research, Data collections, Euphotic zone, *Japan, *Lake Kasumigaura(Japan), Adenosine triphosphate.

The dynamics of dissolved oxygen (DO) were studied during a typical wind condition for each season in Lake Kasumigaura, a hypereutrophic lake. Vertical and diel fluctuation of DO was extremely dynamic during the summer algal bloom in August. The daily oxygen budget at the water surface showed that oxygen dissolving into lake water from the atmosphere was 0.66, 1.18, and 0.65 mg 02/sq cm in November, January, and April, respectively. During the blue-green algal bloom in August, on the other hand, DO liberated 1.16 mg 02/sq cm/day. As the vertical transport of DO for the typical local-wind (1 to 2 m/s) was only one order of magnitude greater than for at the windless condition, the stability of oxygen conditions in the dysphotic zone could not be disturbed greatly by the wind stress. (Humphreys-ISWS)
W80-02684

DEPOSITION OF NUTRIENTS AND MAJOR IONS BY PRECIPITATION IN SOUTH-CENTRAL ONTARIO,
Ontario Ministry of the Environment, Rexdale (Ontario). Limnology and Toxicity Section.
W. A. Scheider, W. R. Snyder, and B. Clark.
Water, Air, and Soil Pollution, Vol 12, No 2, p 171-185, August 1979. 4 Fig, 4 Tab, 43 Ref.

Descriptors: *Water pollution sources, *Precipitation(Atmospheric), *On-site investigations, *Lakes, *Canada, Ions, Water properties, On-site data collections, Nutrients, Fallout, Phosphorous, Nitrogen, Nitrates, Watersheds(Basins), Pollutants, Iron, Hydrogen, Calcium, Magnesium, Sodium, Potassium, Sulfates, Chlorine, *Harp Lake(Ontario).

As part of a study of the substance budgets of lakes in south-central Ontario, a network of precipitation collectors (8 bulk, 7 wet only) was operated to measure the deposition of nutrients and major ions. Results were reported for total P, total Kjeldahl N, NO3(-)-N; and total N H4(+)-N; and total N, Fe, H(+), Ca(++), Mg(++), Na(+), K(+) SO4(--), and CL(-), for a two year period (August 1976-July 1978). On an equivalent basis, the dominant anion in both bulk and wet precipitation was SO4(--), with H(+) the dominant cation. Precipitation in the study area is more acidic than that analyzed at any other location on the Canadian Shield to date. Concentrations of ions varied by 1 to 3 orders of magnitude between individual precipitation events and annual deposition varied by as much as 2-fold in the two years of study. Annual wet deposition contributed greater than 60% of bulk deposition for all substances except total P. Seasonal trends in deposition with summer maxima were noted for most ions. For Harp Lake, a small Precambrian Lake with a lake area of 12.6% of its total drainage area, precipitation input directly to the lake surface was an important source of nutrients and major ions. This was especially the case for P, N, and H(+) because these substances were retained by the terrestrial drainage basin. (Humphreys-ISWS)
W80-02685

THE EFFECT OF HEAVY METALS AND OTHER POLLUTANTS ON THE SEDIMENTS OF ONONDAGA LAKE,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. W. Effler, M. C. Rand, and T. A. Tamayo.
Water, Air, and Soil Pollution, Vol 12, No 2, p 117-134, August 1979. 8 Fig, 6 Tab, 27 Ref.

Descriptors: *Water pollution sources, *Heavy metals, *Sediments, *Lakes, *New York, Water pollution, Pollutants, Water chemistry, Lead, Calcium, Iron, Phosphorous, On-site investigations, Water properties, Biochemical oxygen demand, Alkalinity, Copper, Zinc, Chromium, Industrial wastes, On-site data collections, Profiles, *Onondage Lake(NY).

Onondaga Lake is a small, highly polluted lake located within Metropolitan Syracuse, New York. The Lake has received the domestic effluents and much of the industrial wastes from the area during the last century of its development. Physical and chemical characterization of the recent sediments of Onondaga Lake indicates significant pollution based alterations to the system. 210Pb data depict an extremely high sedimentation rate within the consolidated layers (5 to 9 cm/yr) that has resulted largely from the loading of the Lake with industrially derived Ca. A further alteration of the sedimentary system is the very extensive flocculent layer (up to 2.5 m deep) between the overlaying water and the consolidated sediments. The chemistry of the sediments, though not unusual in dominant component makeup for a hardwater lake, is characterized by very severe heavy metal and Fe contamination that has resulted from culturally derived loadings. Heavy metals and P are concentrated within the upper flocculent strata. Indirect evidence was presented for the upward vertical migration of heavy metals within the sedimentary system. (Humphreys-ISWS)
W80-02686

MECHANICS OF SEDIMENT TRANSPORTATION AND ALLUVIAL STREAM PROBLEMS,
Roorkee Univ. (India).
For primary bibliographic entry see Field 2J.
W80-02700

2J. Erosion and Sedimentation

MATHEMATICAL MODEL OF HEAVY METAL TRANSFER AND TRANSPORT IN LAKE ERIE,
Bowling Green State Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W80-02407

SEDIMENTATION AND USEFUL LIFE OF RESERVOIRS,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W80-02468

COMPOSITION, INTERNAL STRUCTURES, AND AN HYPOTHESIS OF FORMATION FOR DRUMLINS, WAUKESHA COUNTY, WISCONSIN, U.S.A.,
Wisconsin Univ.- Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2C.
W80-02481

THE MECHANICS OF DRUMLIN FORMATION WITH PARTICULAR REFERENCE TO THE CHANGE IN PORE-WATER CONTENT OF THE TILL,
Brock Univ., St. Catharines (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W80-02482

POTENTIAL HAZARDS FROM FLOOD-FLOWS AND DEBRIS MOVEMENT IN THE FURNACE CREEK AREA, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA-NEVADA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. R. Crippen.
Geological Survey open-file report 79-991, July 1979. 23 p, 8 Fig, 1 Tab, 9 Ref.

Descriptors: *Flood flow, *Debris avalanches, *Hazards, *Arid lands, *Deserts, Mountains, Cloudbursts, California, Nevada, *Death Valley National Monument, *Furnace Creek area(CA), Funeral Mountains(CA).

Death Valley is known as the driest and hottest region in the United States. Despite the aridity of the valley itself, however, very heavy rainfall sometimes occurs in the nearby mountains. Such violent rainstorms are likely to be of relatively

short duration and to occur over rather small areas; nevertheless, they sometimes produce large floodflows that in turn cause severe erosion and flows of debris. The debris-laden flows may be hazardous to life and property. Given sufficient knowledge of the hydrologic and hydraulic environment, the degree of hazard can be estimated. Potential hazards are defined for areas in the vicinity of the Furnace Creek fan and the Park Service residential area. (Woodard-USGS)
W80-02591

ASSESSMENT OF SEDIMENT TRAP COLLECTION EFFICIENCY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
B. T. Hargrave, and N. M. Burns.
Limnology and Oceanography, Vol 24, No 6, p 1124-1136, November 1979. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Sediments, *Sampling, *Instrumentations, Theoretical analysis, On-site investigations, Turbulence, Mixing, Sedimentation rates, Suspended solids, Sedimentation, *Sediment traps.

Theoretical considerations of the effects of turbulence around and within sedimentation traps showed that the aspect ratio (height:mouth opening) of the traps is important in determining particle retention. Collection efficiency and comparative measures of deposition per unit area in traps of various design were independent of this ratio in calm water, but an asymptotic relation of increased collection efficiency with higher aspect ratio existed under nonstagnant conditions. Turbulent mixing in a water column could be assessed by comparisons of deposition in collectors exposed simultaneously but having different aspects ratios. (Sims-ISWS)
W80-02670

AMINO ACID DIAGENESIS AND ADSORPTION IN NEARSHORE ANOXIC SEDIMENTS,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
J. K. Rosenfield.
Limnology and Oceanography, Vol 24, No 6, p 1014-1021, November 1979. 3 Fig, 3 Tab, 29 Ref. NSF 73-00365/GA-40002.

Descriptors: *Diagenesis, *Adsorption, *Amino acids, *Sediments, Sampling, Coasts, Shores, Chemical analysis, Analytical techniques, Laboratory tests, Bacteria, Organic matter, Sediment-water interfaces, Tidal waters, Nearshore sediments, Anoxic sediments.

Amino acid diagenesis and free amino acid adsorption by sediments were studied in cores of nearshore anoxic sediments from Long Island Sound, Florida Bay, and Pettaquamscutt River (Rhode Island). Both organic nitrogen and amino acid content decreased by a factor of about 2 in the top meter of the sediment. Individual amino acid profiles showed that the acidic and neutral amino acids, despite their different chemical composition, appeared to be equally utilized in both clastic and carbonate sediments. This result differed from the preferential utilization of certain amino acids generally found in deep-sea sediments. The results of laboratory adsorption experiments suggested that in clay sediments, free amino acids are predominantly adsorbed by the organic matter in the sediment rather than by the clay minerals. However, in the carbonate sediments, the organic matter seems to inhibit the adsorption of free amino acids on the carbonate grains. (Sims-ISWS)
W80-02673

MECHANICS OF SEDIMENT TRANSPORTATION AND ALLUVIAL STREAM PROBLEMS,
Roorkee Univ. (India).
R. J. Garde, and K. G. Ranga Raju.
John Wiley and Sons, New York, New York, 1977. 483 p.

Descriptors: *Alluvial channels, *Sediment transport, *Sediment load, *Publications, *Hydraulic engineering, *Sedimentation, Hydraulics, Theoretical analysis, Analytical techniques, Sediments, Bed load, Equations, Sediment control, Model studies, Bed load samplers, Sampling, Rivers, Canals, River training, Bank protection, Channel erosion, Scour, Sediment discharge, Density currents, Reservoirs, Saltation, Incipient motion.

The subjects of sediment transport and flow in alluvial streams are gaining importance with the increasing utilization of water resources. In this book the authors attempted to summarize and synthesize the vast amount of information on sediment transport and problems related to alluvial streams scattered in numerous journals, monographs, and other research publications. The contents of the book were divided into two parts. The first part, consisting of 8 chapters, dealt with the theory of sediment transport and included such aspects as properties of sediments, incipient motion condition, flow regimes, resistance to flow, bed load transport, suspended load transport, and total load transport. The second part, consisting of another 8 chapters, dealt with applied problems such as sediment samplers and sampling, stable channels, alluvial streams, variations in stream bed elevation and plan forms, sediment control, river training, and miscellaneous problems such as model studies, mud flows, density currents, and sediment transport through pipes. (Humphreys-ISWS)
W80-02700

2K. Chemical Processes

THE EFFECT OF HYDROGEOLOGY ON VARIATIONS IN THE ELECTRICAL CONDUCTIVITY OF GROUNDWATER FLUCTUATIONS,
Andhra Univ., Waltair (India). Dept. of Geophysics.
For primary bibliographic entry see Field 2F.
W80-02412

DESIGN OF A NETWORK FOR MONITORING GROUND-WATER QUALITY IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W80-02588

SELECTED WELL INVENTORY AND CHEMICAL ANALYSIS OF GROUND WATER, PARTS OF MISSOULA AND POWELL COUNTIES, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-02590

AN EPR STUDY OF THE REDUCTION OF VANADIUM(V) TO VANADIUM(IV) BY FULVIC ACID,
New Hampshire Univ. Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 1A.
W80-02601

ACID PRECIPITATION: MEASUREMENT OF PH AND ACIDITY,
Virginia Univ., Charlottesville, Dept. of Environmental Sciences.
J. N. Galloway, B. J. Cosby, Jr., and G. E. Likens.
Limnology and Oceanography, Vol 24, No 6, p 1161-1165, November 1979. 1 Fig, 17 Ref. NOAA 04-5-022-24.

Descriptors: *Acidity, *Hydrogen ion concentration, *Measurement, *Analytical techniques, Water chemistry, Acids, Chemical analysis, Water pollution, Pollutants, Sampling, Monitoring, Chemistry, Precipitation(Atmospheric), *Acid precipitation.

The pH and acidity of precipitation are difficult to measure accurately because of the low ionic strength of the samples. Use of measured pH to estimate hydrogen-ion concentration may err by as much as 50% if activity coefficients, junction and streaming potentials, and non-Nernstian behavior of the electrode system are ignored. The magnitude of the individual errors was assessed, and procedures for measuring pH and acidity to reduce the total error to + or - 5% were recommended. (Sims-ISWS)
W80-02667

ACIDIFICATION AND OTHER CHEMICAL CHANGES IN HALIFAX COUNTY LAKES AFTER 21 YEARS,
Fisheries and Marine Service, Halifax (Nova Scotia).
W. D. Wyatt, D. Scott, and S. Ray.
Limnology and Oceanography, Vol 24, No 6, p 1154-1161, November 1979. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Lakes, *Acidity, *Water chemistry, *Sampling, Air pollution, Air pollution effects, Precipitation(Atmospheric), Chemicals, Sodium, Magnesium, Calcium, Potassium, Sulfates, Hydrogen ion concentration, Geology, Rocks, Runoff, Chemical analysis, Data processing, Regression analysis, *Nova Scotia, Acid precipitation.

Of 23 lakes sampled in 1955, 16 show no sign of significant physical alterations within their drainage basins over a 21-year interval, so that chemical changes in these lakes can be assumed to reflect changes in atmospheric inputs. In all 16, the pH levels have declined, with greater declines in the higher pH (near neutrality) lakes. After correction for sea-salt input, concentrations of sodium, magnesium, calcium, potassium, and sulfate show no significant change. Sulfate and hydrogen ions are significantly correlated, and both show significant regressions on distance from the major sulfur-emitting industrial sources in the Halifax area. Although the area as a whole may be subject to an influx of acid pollutants via long distance atmospheric transport, for lakes near Halifax the high acid levels largely are due to local pollution. (Sima-ISWS)
W80-02668

HYDROGEOCHEMISTRY OF THE CORSAGLIA VALLEY, MARITIME ALPS, PIEDMONT, ITALY,
Turin Univ (Italy). Ist. di Geologia e Paleontologia.
For primary bibliographic entry see Field 2F.
W80-02679

2L. Estuaries

THE BARNACLE, BALANUS SUBALBIDUS, AS A SALINITY BIOINDICATOR IN THE OLIGOHALINE ESTUARINE ZONE,
New Orleans Univ., LA. Dept. of Biological Sciences.
M. A. Poirrier, and M. R. Partridge.
Estuaries, Vol 2, No 3, p 204-206, September 1979. 4 Fig, 6 Ref. OWRT A-045-LA(1).

Descriptors: *Estuaries, *Salinity, *Bioindicators, *Gulf of Mexico, Biological communities, Size, Marine biology, Biology, Sampling, Surveys, Coasts, Analytical techniques, Regression analysis, Barnacles, Oligohaline zone.

The distribution and size of the barnacle Balanus subalbidus were studied along salinity gradients in coastal Louisiana and Mississippi. It was common in gradient estuaries occurring in salinities ranging from near freshwater to 16 ppt. It was the dominant barnacle species in the oligohaline zone. But at salinities above 6 ppt, its relative abundance decreased, and it was replaced by B. improvisus and B. eburneus. Its low-salinity limit corresponded to the boundary between the oligohaline and freshwater estuarine salinity zones and there was a high negative correlation between size (basal rostral-carinal diameter) and salinity. Its size and distribution could be used to determine prevailing salinity at a site because of its abundance and uniform distribution in oligohaline areas. (Sims-ISWS)
W80-02413

PROPERTIES OF THE SEAWATER-AIR INTERFACE. DYNAMIC SURFACE TENSION STUDIES,
Institut Rudjer Boskovic, Rovinj (Yugoslavia). Center for Marine Research.
Dj. Dragcevic, M. Vukovic, D. Cukman, and V. Pravdic.
Limnology and Oceanography, Vol 24, No 6, p 1022-1030, November 1979. 7 Fig, 27 Ref.

Descriptors: *Air-water interfaces, *Sea water, *Surface tension, *Laboratory tests, Films, Thin films, Oils, Organic compounds, Chemicals, Equipment, Instrumentation, Hydrogen ion concentration, Oceans, Oceanography, Oleic acid, Surface layers.

The properties of the seawater-air interface were studied by laboratory measurement of the dynamic surface tension of seawater and of samples of artificial seawater on which films of oleic and stearic acid were spread. A commercially available, automatic recording apparatus was used, consisting of a modified Langmuir trough with motor-driven surface wiper blades, a Wilhelmy plate surface tension electric microbalance, and a recorder. Comparison of the shape of the dynamic surface tension-surface area curves of original seawater samples with those of artificial ones showed that the 'expanded-' type surface film, produced by surface spreading of oleic acid, serves as an adequate model of conditions at the real seawater-air interface. This model and its surface tension dynamics could be used, in addition to chemical analytical data, as a quantitative measure of the state of the seawater-air interface and its role in controlling the transport of gases and other soluble materials between the atmosphere and the oceans. (Sims-ISWS)
W80-02672

AMINO ACID DIAGENESIS AND ADSORPTION IN NEARSHORE ANOXIC SEDIMENTS,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W80-02673

MASS TRANSFER VERIFICATIONS OF TIDAL FROUDE MODELS,
Old Domnion Univ., Norfolk, VA.
C. Blari, and C. Y. Kuo.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 105, No HY12, p 1561-1565, Technical Note, December 1979. 1 Tab, 19 Ref, 1 Append.

Descriptors: *Hydraulic models, *Tidal waters, *Mass transfer, *Estuarines, Model studies, Froude number, Calibrations, Tracers, On-site investigations, Mixing, Reviews, Coasts, Model verification.

Similitude of tidal hydraulic models is routinely verified with respect to model/prototype tide heights and current velocities and, in mass transfer (i.e., spatial and temporal distribution of a pollutant, dye tracer, or similar dissolved substance) is less frequently investigated, chiefly because of the prohibitive cost of protopype dye release tests. Laboratory-field verification tests reported from 1966-1976 demonstrated that mass transfer similitude has in fact been attained in models of widely varying scale, distortion, and hydraulic characteristics. For more detailed information on the verification tests one must turn to the references or, in some cases, to the investigators themselves for information on tracers used, vertical tracer distribution, nature of model friction elements, river discharge and tidal data, morphology and hydrography of the water bodies, and other information essential for analyzing the results. Given the difficulty and expense of such studies, further and deeper analysis of already completed experiments should be an efficient approach to 'continued improvements in understanding' the mixing process. (Humphreys-ISWS)
W80-02695

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

ADVANCED POLY(PIPERAZINEAMIDE) REVERSE OSMOSIS MEMBRANES,
FilmTec Corp., Minnetonka, MN.
J. E. Cadotte, R. S. King, and N. A. Newkumet.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127574, Price codes: A04 in paper copy, A01 in microfiche. Final Technical Progress Report to the Office of Water Research and Technology, 1979. 48 p, 20 Tab, 6 Ref. OWRT C-80011-S(8512)(1), 14-34-0001-8512.

Descriptors: *Reverse osmosis, *Permselective membranes, *Semipermeable membranes, *Desalination processes, Membranes, Membrane processes, Saline water, Polypiperazineamide, Piperazine.

Poly(piperazineamide) thin-film composite reverse osmosis membranes were prepared by interfacially reacting piperazine compounds with a mixture of isophthaloyl and trimesoyl acid chlorides. Reaction of piperazine itself with these acylhalides gave membranes with high flux and excellent salt rejections towards salts with divalent anions, but relatively poor salt rejections toward salts with monovalent anions. About 95% seawater rejections were possible. A variety of water-soluble, amine-terminated piperazine oligomers were prepared by reaction of an excess of piperazine with polyfunctional acyl halides. These were then used in the above interfacial reaction step. Cyanuric chloride-piperazine adducts showed performance advantages over other in preparation of reverse osmosis membranes interfacially. In seawater tests at 1000 psi and 25C, fluxes of 15 to 20 gfd at 97 percent salt rejection were attainable for poly(piperazineamides) containing cyanuric amide segments. These latter membranes were not chlorine-resistant.
W80-02401

SECONDARY ICE NUCLEATION AND CRYSTALLIZER-PERFORMANCE OPTIMIZATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
E. Woltz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-130446, Price codes: A03 in paper copy, A01 in microfiche. Doctoral Thesis Digest, August 1975. 31 p, 19 Ref. OWRT (3268)(2), 14-30-3268.

Descriptors: *Desalination, *Freezing, *Crystal growth, Crystallization, Nucleation, Supercooling, Potassium chloride, Sodium chloride.

A batch crystallizer was used to investigate the secondary nucleation of ice in NaCl and KCl solutions. The kinetics of nucleation were determined over a range of salt concentrations, agitation power inputs, and solution subcoolings. The nucleation kinetics were found to be consistent with a mechanism in which the nuclei were produced by collisions between the ice crystals and the impeller and crystallizer surfaces. The specific nucleation rate was found to be preportional to the third moment of the particle size distribution. The data were used to develop a correlation of the nucleation rate as a function of subcooling, power agitation rate, and the third moment of the size distribution. (Sarofim-MIT)
W80-02608

HYDRODYNAMIC AND HEAT TRANSFER EFFECTS IN A PACKED BED MELTER-CONDENSER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
W. L. Sifleet.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-132657, Price codes: A03 in paper copy, A01 in microfiche. Doctoral Thesis Digest, January 1975. 28 p, 6 Fig, 41 Ref. OWRT (3268)(3), 14-20-3268.

Descriptors: *Heat transfer, *Condensation, *Desalination, Freezing, Crystal growth.

Data are presented on liquid-phase hold-up and on heat transfer for geometries similar to those which are likely to be employed in a packed bed melter-condenser. Hold-up was studied in a string-of-spheres column for water, for aqueous sucrose solutions, and for suspensions of polyethylene particles in water. The data for water and for sucrose solutions show excellent agreement with a new theory which as been developed for this purpose. Rather surprisingly, the suspensions of polyethylene behaved exactly as did water alone. Heat transfer rates were studied for the condensation of n-butane upon a film of cold water which as caused to flow over a single sphere. The results are in satisfactory agreement with simple penetration theory. (Smith-MIT)
W80-02609

MASS TRANSFER FROM SPHERES AND DISCS IN TURBULENT AGITATED VESSELS,
Massachusetts Inst. of Technology, Cambridge, Dept. of Chemical Engineering.
P. H. Wadia.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-132640, Price codes: A05 in paper copy, A01 in microfiche. Doctoral Thesis Digest, 1974. 95 p, 39 Fig, 7 Tab, 29 Ref. OWRT (3268)(4), 14-20-3268.

Descriptors: *Mass transfer, *Desalination, *Freezing, Crystal growth.

Mass transfer coefficients for virtually neutrally buoyant spheres and discs were measured by observing the rate of dissolution of sparingly soluble organic solutes in water and water-glycerol solutions. An extensive experimental investigation of all the important independent transport variables was conducted, with special emphasis on studies with industrial scale equipment. The variables studied were: vessel diameter, impeller design, type and geometry, impeller location, impeller to tank diameter ratio, liquid height, impeller speed and the specific power input, particle diameter, particle concentration, solute diffusivity, and fluid viscosity. A theory is developed on the basis of Kolmogoroff's notion of locally isotropic turbulence, and generalized correlations which are consistent with the proposed theory are presented. Attention is drawn to the mass transfer limited growth of ice crystals. (Smith-MIT)
W80-02610

PROCESS AND APPARATUS FOR PURIFYING SEA WATER BY REVERSE OSMOSIS,
Permo SA, Rueil Malmaison (France). (Assignee).
H. Lerat.
U.S. Patent No 4,169,789, 11 p, 2 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 987, No 1, p 168-169, October 2, 1979.

Descriptors: *Patents, *Desalination, *Water purification, *Water treatment, *Sea water, Reverse osmosis, Filtration, Semipermeable membranes, Offshore platforms, Potable water.

Sea water is purified by reverse osmosis in an offshore installation where sea water is withdrawn from the sea by a low pressure pump and passed through plural-stage physical filters having decreasing degrees of porosity to remove suspended particles and colloids from the sea water. The filtered sea water is then fed by a high pressure pump, at a controlled pressure above the osmotic pressure of the sea water to a reverse osmosis module. A portion of the sea water permeates through a semipermeable membrane of the module to form purified potable water and the remaining sea water having its dissolved salt concentration increased, is discharged back to the sea. The reverse osmosis module is operated so that the conversion level, measured in percent and equal to the volume of purified water divided by the volume of sea water fed to the module, is maintained below a maximum value to prevent the formation of sulfates and carbonates on the membrane. (Sinha-OEIS)

Group 3A—Saline Water Conversion

W80-02629

DESALINATION BY THE INVERSE FUNCTION OF THE KNOWN (SALTING OUT) EFFECT WITHIN AN IMPROVED CENTRIFUGE,
S. A. Kirk, and C. F. Kirk.
U.S. Patent No 4,170,328, 6 p, 1 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 358, October 9, 1979.

Descriptors: *Patents, *Desalination, *Water purification, Sea water, Separation techniques, Hydrogen, Gases, Centrifugation, Recycling, 'Salting out' effect.

Hydrogen gas is injected into sea water preceding treatment in an improved pocket type centrifuge. The catalytic effects of hydrogen gas within the confining walls plus hydraulic, inertia, and centrifugal forces acting within the centrifuge give an inverse function of the known salting-out effect in which the hydrogen rejects the salt and floats the freshwater from the system. The hydrogen gas is separated from the fresh-water by a second improved pocket type centrifuge and recycled for efficiency in the process. (Sinha-OEIS)
W80-02633

APPARATUS FOR THE DESALINATION OF SEA WATER, WITH AUTOMATIC REGULATION OF THE FRESH AND SALT WATER LEVELS,
Snam Progetti, S.p.A., Milan (Italy). (Assignee).
G. Pagani.
U.S. Patent No 4,170,514, 4 p, 4 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 415, October 9, 1979.

Descriptors: *Patents, *Desalination, *Water treatment, *Sea water, Separation techniques, Flash distillation, Desalination apparatus.

In a sea water desalination apparatus, the improvement consists in the fact that the levels of sea water and fresh water in the several stages of the multistage installation are regulated by a device comprising of piezometric tubes in combination with cylindrical sleeves surrounding these tubes and having slots so proportioned as to give a preselected pressure drop. (Sinha-OEIS)
W80-02636

3C. Use Of Water Of Impaired Quality

GEOTHERMAL: AN IDEA WHOSE TIME HAS COME...,
For primary bibliographic entry see Field 8A.
W80-02662

3E. Conservation In Industry

METHOD AND APPARATUS FOR RECYCLING WATER IN A CAR WASH,
M. K. Allen, and R. S. Weber.
U.S. Patent No 4,168,231, 6 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 662, September 18, 1979.

Descriptors: *Patents, *Industrial water, *Waste water treatment, *Separation techniques, Centrifugation, Recycling, Water conservation, Water reuse, Equipment, Car washes.

A pump supplies water from a clarifier tank to a centrifugal separator, where solid particles are removed, and then to wash spray heads. A return or bypass conduit with a pressure-operated, modulating one-way valve permits water to pass from the outlet of the separator to the inlet of the pump in sufficient volume to ensure that the separator will operate at high velocity even when there is little or no demand for processed water at the spray heads as well as to recycle centrifuged water to further clean it. A float tank is coupled to and extends from the return conduit for enabling any trapped air to be expelled from the system. In addition, an air-bleeding conduit with a one-way check valve is placed in parallel with the return conduit to permit air flow in the direction opposite to that allowed by the valve to enable air to be removed from the system, especially when the pump is primed by supply of additional water. (Sinha - OEIS)
W80-02616

APPARATUS FOR RECOVERY OF METALS FROM METAL PLATING BATHS AND NEUTRALIZING TOXIC EFFLUENTS THEREFROM,
Instytut Mechaniki Precyzyjnej, Warsaw (Poland).
For primary bibliographic entry see Field 5D.
W80-02643

SUPPRESSION OF POLLUTION IN MINERAL FIBER MANUFACTURE,
Saint-Gobain Industries, Neuilly-sur-Seine (France). (Assignee).
For primary bibliographic entry see Field 5D.
W80-02646

3F. Conservation In Agriculture

ROTARY SPRINKLER IMPACT ARM SPRING ADJUSTMENT,
Telsco Industries, Dallas, TX. (Assignee).
H. C. Ridgway.
U.S. Patent No 4,162,038, 10 p, 8 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 984, No 4, p 878-879, July 24, 1979.

Descriptors: *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation practices, Irrigation efficiency.

A rotary sprinkler has a laterally directed nozzle cooperating with the arm to rotate the nozzle and an impact arm journaled on a shaft extending above the nozzle. The arm is also mounted within a cage extending above the nozzle. The cage includes a pair of arms extending from the nozzle on opposite sides of the shaft and terminating at their upper ends remote from the nozzle in a top plate. A helical spring surrounds the shaft and is secured at its lower end to the arm. A bushing is secured at the top end of the spring and is seated in the top plate of the cage. The bushing may be manually adjusted relative to the plate to vary the force applied by the spring to the impact arm. The sprinkler is placed in a bucket-like housing positioned within the ground so that the mouth of the housing is flush with the ground surface. The sprinkler responds to the passage of water through the nozzle by rising from a lower first position retracted in the housing to a raised second position out of the housing. A top cover sized to mate with the mouth of the housing is attached to the top plate of the cage so that when the sprinkler is in the first position the top cover mates with the mouth of the housing to enclose the sprinkler. The top cover is supported above and protects the sprinkler. (Sinha-OEIS)
W80-02448

RECLAMATION POLICY AND THE WATER SUBSIDY, AN ANALYSIS OF THE DISTRIBUTIONAL CONSEQUENCES OF EMERGING POLICY CHOICES,
California Univ., Davis. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6B.
W80-02455

TWO-PIECE WEAR-RESISTANT SPRAY NOZZLE CONSTRUCTION,
Rain Bird Sprinkler Mfg. Corp., Glendora, CA. (Assignee).
R. von Bernuth, and D. Simpson.
U.S. Patent No. 4,168,033, 6 p, 6 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 603-604, September 18, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation practices, Irrigation efficiency, Irrigation operations and maintenance, Water delivery.

A spray nozzle is described having a brass housing and a urethane insert that is relatively resistant to wear by contact with the flow of irrigation water. The insert protects the more costly housing from erosion and is easily replaced if it becomes worn or if it is necessary to change the spray pattern. The housing can form a sleeve in which the insert is slidably received so that the housing is completely insulated from contact with the water flow. In one embodiment, the insert forms a concave defector having ridges on a surface impinged by the water so that the spray emitted consists of discrete streams for greater distance and wind resistance. The water is emitted toward the deflector through an oblong orifice for more uniform lateral water distribution. (Sinha-OEIS)
W80-02613

SOAKER HOSE,
Entek Corp., Dallas, TX. (Assignee).
J. E. Turner.
U.S. Patent No 4,168,799, 7 p, 7 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 861, September 25, 1979.

Descriptors: *Patents, *Irrigation, *Subsurface irrigation, *Application equipment, Irrigation practices, Irrigation efficiency, Irrigation operation and maintenance.

A product is made of crumbed rubber and synthetic rubber reclaimed from rubber tires with the metal removed. It is ground to a relatively small granular size, such as would pass through a 30-mesh screen, process-mixed through an extruder, with a much smaller binder mix of primarily polyethylene, in the order of 25% by weight, and with approximately 0.5% of the mixture added sulphur and 0.5% oil (such as random mixed grades of automobile engine oil). The resulting product is useful as a soil watering soaker hose that has a high degree of flexibility along its length. During its progress through the extruder there is limited foaming from steam originating from absorbed moisture in the crumbed, reclaimed rubber tire material and from residual gases venting from the material mix causing some open cell fluid flow paths. The foaming with steam and gases also form labyrinth passegeways between the rubber tire granules and the polyethylene binder mix for seeping water to the exterior of the hose without soil-damaging water jets. The soaker hose is usable as a subsurface irrigation buried pipe. (Sinha-OEIS)
W80-02619

COMBINATION HYDRAULIC CYLINDER AND SHOCK ABSORBER,
Allied Products Corp., Chicago, IL (Assignee).
M. A. Quick.
U.S. Patent No 4,168,800, 6 p, 4 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 861, September 25, 1979.

Descriptors: *Patents, *Irrigation, *Application equipment, Sprinkler irrigation, Irrigation practices, Irrigation efficiency, Irrigation operation and maintenance.

Spray booms utilized for applying liquid fertilizer, water or the like, include a powered vehicle, towed vehicle, and an elongated boom generally attached in a cantilevered fashion with discharge nozzles being spaced longitudinally along the boom. The end of the boom attached to the vehicle is pivotally supported for swinging movement in a vertical plane about a fore-and-aft horizontal axis in order to adjust the position of the boom in a vertical plane. Due to the elongated nature of the boom, it is subject to considerable vertical oscillation, bouncing or swinging movement due to the vehicle passing over an uneven terrain. The object of this invention is to provide a combination hydraulic cylinder and shock absorber utilized to cushion and dampen the vertical swinging movement of the spray boom and also to adjust the position of the spray boom and to cushion and dampen the swinging movement of the boom at any adjusted position within the range of adjust-

ment provided by the hydraulic cylinder. (Sinha-OEIS)
W80-02620

AGRICULTURAL WATER PRESSURE GAUGE,
W. C. McMahan.
U.S. Patent No 4,169,386, 4 p, 3 Fig, 1 Ref; Official Gazette of the United States Patent Office, Vol 987, No 1, p 37, October 2, 1979.

Descriptors: *Patents, *Irrigation, Irrigation practices, Irrigation efficiency, Water pressure, Gages, Irrigation operation and maintenance, Farm equipment.

A water pressure gauge for agricultural use comprises no moving parts. A translucent tube has one end provided with a hollow prong or probe that penetrates flexible water conduit. The tube is open at the end opposite the probe and has an outlet opening located near the probe end. With the guage vertically oriented, water reaches a level in the tube dependent upon water pressure. By careful calibration of the outlet relative to an interior baffle, a reasonably satisfactory water pressure gauge is available for irrigation purposes. (Sinha-OEIS)
W80-02626

IRRIGATION PIPE GATE,
Traid Fastener Corp., Alda, NE. (Assignee).
H. E. Damratroski, and R. H. Morton.
U.S. Patent No 4,169,577, 6 p, 7 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 987, No 1, p 103, October 2, 1979.

Descriptors: *Patents, *Irrigation, Irrigation practices, Irrigation efficiency, Water control, Flow control, Pipe flow, Gates.

A longitudinally slidable irrigation pipe gate for opening and closing a longitudinally elongated outlet port in an irrigation pipe has a wall of given finite thickness. The port includes a transversely extending lead-end and a trail-end and at least a portion of the outlet port length is of regular transverse width. The pipe gate comprises a base member having an inner-plate for abuting against the inner surface of the pipe; a resilient annular gasket for providing a water-tight slidable seal between the inner-plate and the inner surface of the pipe; a cover member with extending edges abutting the outside surface of the pipe; and a spring means for connecting the cover member and the inner-plate and resiliently uring them toward the outside surface and the inside surface, respectively. The pipe gate has a closed forward position where the base member and gasket completely cover the periphery of the outlet port and an open rearward position where a portion of the outlet port is not covered. (Sinha-OEIS)
W80-02627

SPRINKLER AND VALVE OPERATOR,
A. N. Filan, and A. L. Filan.
U.S. Patent No 4,171,095, 7 p, 5 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 987, No 3, p 627, October 16, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation operation and maintenance, Irrigation efficiency, Irrigation practices.

A sprinkler and valve operator enables a single rotatable sprinkler head to be mounted coaxially to an upright irrigation pipe valve. The operator is comprised of two independently coaxially rotatable pipe sections that include a central valve operating mechanism. The lower pipe section includes mechanisms for attaching the operator to a standard upright irrigation pipe valve. The valve operating mechanism engages and rotates the irrigation pipe valve actuator in response to rotational movement of the upper pipe section. A removable tripod may be provided to brace the pipe sections against operating forces produced through the rotating sprinkler head. (Sinha-OEIS)
W80-02642

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ENDOHELMINTHS OF SALMONIDA FROM THE ARTIFICIAL LAKE PIVA, MONTENEGRO, YUGOSLAVIA,
Biological Inst., Titograd (Yugoslavia).
For primary bibliographic entry see Field 5C.
W80-02490

HYDROLOGY AND WATER QUALITY IN THE NEDERLO CREEK BASIN, WISCONSIN, BEFORE CONSTRUCTION OF TWO WATER-RETENTION STRUCTURES,
Geological Survey, Madison, WI. Water Resources Div.
P. A. Kammerer, Jr., and M. G. Sherrill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-300 826, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-95, August 1979. 34 p, 21 Fig, 3 Tab, 16 Ref.

Descriptors: *Hydrologic budget, *Small watersheds, *Pre-impoundment, *Water quality, *Wisconsin, Baseline studies, Water temperature, Surface-groundwater relationships, Sediment yield, Hydrologic cycle, Dissolved oxygen, Hydrogeology, Surface runoff, Base flow, Potentiometric level, Geology, Land use, *Nederlo Creek(Wis), *Southwestern Wisconsin, Driftless area, Trout stream, Total nitrogen load, Total phosphorus load, Suspended-sediment load.

The Nederlo Creek basin in southwest Wisconsin is the proposed site of two structures intended to provide recreation and flood protection. Streamflow is fairly constant at base flow, but rapid changes in discharge occur during periods of snowmelt or heavy rain. Mean annual precipitation is 32.5 inches, and mean annual runoff is 6.4 inches. The water is a hard calcium magnesium bicarbonate type. Dissolved-oxygen concentrations in the stream are lowest during the summer when nighttime lows are generally between 7 and 8 milligrams per liter and daily maximums between 11 and 12.5 milligrams per liter. Considerable diurnal water-temperature fluctuation occurs in summer with daily maximum temperatures occasionally reaching 26 C. Estimates of mean annual total phosphorus and total nitrogen loads fall within the ranges of 0.02 to 0.07 and 0.4 to 0.8 tons per square mile, respectively; mean annual sediment loads range from 13 to 60 tons per square mile. Seventy to 80 percent of the total phosphorus, 35 to 55 percent of the total nitrogen, and 74 to 86 percent of the suspended sediment are transported during periods when surface runoff contributes to streamflow. (Woodard-USGS)
W80-02585

CHANGES IN CHANNEL GEOMETRY AND CHANNEL CAPACITY OF ALLUVIAL STREAMS BELOW LARGE IMPOUNDMENT STRUCTURES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Tai Huang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-132632, Price codes: A07 in paper copy, A01 in microfiche. MS Thesis, (1979), 131 p, 39 Fig, 4 Tab, 35 Ref, 2 Append. OWRT A-075-KAN (2).

Descriptors: *Alluvial streams, *Impoundment structures, *Channel morphology, Distribution patterns, Channel geometry, Channel capacity.

Alluvial streams are known to form their own channels, and the characteristics of the channels is in a state of equilibrium with the bank material, and water and sediment discharge patterns. Construction of large impoundment structures on alluvial streams alters their water and sediment discharge patterns. Changes in channel geometry and channel capacity are therefore induced. In this study, the changes in channel geometry and channel capacity caused by large impoundment structures are examined. The theories of fluvial morphology and the theories of open channel flow are used for analyses. Both approaches lead to a similar conclusion that the stream below a dam tends to form a relatively narrower and deeper channel. United States Geological Survey streamflow measurement data of seven Kansas streams are used to test this conclusion. Hydraulicaly, the morphological changes of the stream channel are attributed to channel degradation and increased channel roughness. A channel degradation model is presented and applied on the Wakarusa River below Clinton Dam. The result shows a maximum degradation of 11 feet which is probably too excessive. However, the result also indicates a consistent trend that has been predicted by the analyses. With carefully chosen values for the stream parameters, the model can be used satisfactorily to predict changes in channel geometry and channel capacity for a stream reach below a large impoundment structure.
W80-02611

ENDING ACID MINE WATER POLLUTION,
For primary bibliographic entry see Field 5D.
W80-02658

SWMM APPLICATION TO COMBINED SEWERAGE IN NEW HAVEN,
Cardinal Engineering Associates, Meriden, CT.
For primary bibliographic entry see Field 2E.
W80-02694

COMPARISON AND COMBINATION OF TWO RECENT PROPOSALS FOR A GENERALIZED PENMAN EQUATION,
Dar es Salaam Univ., Tanzania. Dept. of Physics.
For primary bibliographic entry see Field 2D.
W80-02699

4B. Groundwater Management

AVAILABILITY OF GROUND WATER ON FEDERAL LAND NEAR THE AK-CHIN INDIAN RESERVATION ARIZONA--A RECONNAISSANCE STUDY,
Geological Survey, Tucson, AZ. Water Resources Div.
R. P. Wilson.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, microfiche $9.00, paper copy $8.25. Geological Survey open-file report 79-1165, June 1979. 36 p, 13 Fig, 3 Tab, 20 Ref.

Descriptors: *Groundwater availability, *Water wells, *Aquifer characteristics, *Water yield, *Water quality, Water levels, Indian reservations, Arizona, Water supply, Drawdown, Groundwater movement, Projections, Water resources development, Evaluation, *Ak-Chin Indian Reservation(Ariz).

Sufficient ground water to provide about 2.1 million acre-feet in a 25-year period is available for delivery to the Ak-Chin Indian Reservation from Federal land in the Vekol Valley, Waterman Wash area, and Bosque area in south-central Arizona. Withdrawal of 85,000 acre-feet per year as required by the Ak-Chin water-supply act--Public Law 95-328--will greatly deplete the amount of water in storage and may cause land subsidence in the areas. Study concurrent with well-field development will enable design changes to minimize pumping costs, water-level declines, movement of poor-quality water into the well fields, and potential land subsidence and associated earth fissures. Surface and bore-hole geophysical testing, aquifer tests, and the development of simulative mathematical models will accomplish these goals and permit quantitative evaluations of the potential deleterious effects resulting from development of the water supply. (Woodard-USGS)
W80-02581

GROUND WATER CONTROL TO THE RESCUE: TWO CASE HISTORIES,
Golder Associates, Mississsuga (Ontario).
For primary bibliographic entry see Field 8H.
W80-02648

GROUND WATER STORAGE FOR CALIFORNIA WATER PROJECT,
California State Dept. of Water Resources, Los Angeles. Southern District.
J. J. Coe.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 105, No IR3, p 305-315, September, 1979. 5 Fig, 3 Ref.

Descriptors: *Conjunctive use, *Underground storage, *Ground water basins, California, Legal aspects, Institutional constraints, State governments, Local governments, Water resources development, Government interrelations.

Due to the expense and delay involved in constructing surface storage facilities, the California Department of Water Resources is examining the feasibility of using ground water basins. Under the State Water Project (SWP), water would be placed underground during periods of ample supply and withdrawn and used in subsequent dry years. This reduces wastage of water to saline bodies and increases the yield over that achievable from separate operation of surface water and ground water projects. Also storage of water would raise ground water levels and reduce pumping costs and would improve ground water quality in many basins. Recent state Supreme Court decisions have provided a strong legal framework for the practice of conjunctive use. Major institutional considerations involve competition between local and state agencies over the use of conveyance facilities, spreading basins, underground storage space and wells. These conflicts can often be solved by facility enlargement and scheduling. Local and state agencies should develop a plan for joint use of water supplies, facilities, and storage space to achieve local water management goals as well as increasing the yield of the SWP. (Purdin-NWWA)
W80-02663

4C. Effects On Water Of Man's Non-Water Activities

WATER QUALITY EFFECTS OF LEAD FROM RECREATIONAL BOATING,
California State Coll., Stanislaus, Turlock. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W80-02403

4D. Watershed Protection

MECHANICS OF SEDIMENT TRANSPORTATION AND ALLUVIAL STREAM PROBLEMS,
Roorkee Univ. (India).
For primary bibliographic entry see Field 2J.
W80-02700

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

AN INDICATOR-PREDICTION MODEL FOR ECOSYSTEM PARAMETERS OF WATER QUALITY,
Delaware Univ., Newark. School of Life Sciences.
M-H. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127228, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center, University of Delaware, Newark, Research Project Technical Completion Report, November 1979, 10 p, 1 Fig, 1 Tab, 3 Ref. OWRT A-043-DEL(4), 14-34-0001-9008.

Descriptors: Water quality, Toxicity, Naphthalene, Fish, Cortisol, Glucose, Histopathology.

A mathematical model, based on fit to a rectangular hyperbola, has been developed for use in predicting the toxicity of chemical pollutants in fish. The model was tested by exposing Fundulus heteroclitus to a range of concentrations of naphthalene between 0 and 30 mg/L. Observations of mortality, condition index, tissue changes, and serum cortisol and glucose levels were tested as indicators of toxic effect. Mortality data obtained in these experiments were used to calculate the dose for which appearance of the response would require an infinite exposure time. This was defined as the 'safe level' for the indicator in question. Using mortality as the indicator, the model predicted the safe level to be 1.69 mg/L. This prediction appears to be valid since 1.73 mg/L was lethal at 15 days and no mortality occurred in fish exposed to 1.60 mg/L naphthalene for 30 days. Of the other toxicity indicators tested, only sensory cell necrosis was a more sensitive indicator of toxicity than mortality. Serum cortisol and glucose, and ischemia of brain and liver occurred only in animals which were near death. Condition index did not change in exposures as long as 30 days.
W80-02402

HEAVY METALS IN FISH FROM A RESERVOIR RECEIVING URBAN AND AGRICULTURAL RUNOFF,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
S. P. Gawlik, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127566, Price codes: A07 in paper copy, A01 in microfiche. MS Thesis, March 1979, 128 p, 4 Fig, 9 Tab, 103 Ref, 5 Append. OWRT B-103-VA(3).

Descriptors: *Nonpoint pollution, *Agricultural runoff, Heavy metals, Bass, Carp, Watershed, Reservoir, Spectrophotometry, *Occoquan watershed, Bluegill.

Between 3/24/78 and 5/26/78, largemouth bass, bluegill, and common carp were harvested from three stations in the Occoquan Watershed. Bass and bluegill were harvested from Pelham Reservoir which served as a control. Homogenized fillet and liver tissue from a total of 276 fish were digested and analyzed by Atomic Absorption Spectrophotometry for cadmium, chromium, copper, lead, zinc, and total mercury (1) to determine whether the amounts of metals represent any hazard to humans when fish are used as food; (2) to discover whether the geographical patterns of metal concentrations point to source areas or identify specific causes of elevated stream concentrations. Concentrations of mercury were shown to increase in the fillet tissue of carp, bass, and bluegill as a function of weight and length. Bass from both watersheds were occasionally found to exceed the guideline for total mercury. No other metals were shown to present any significant public health hazard. Zinc and copper concentrations in liver and fillet tissue of bass and bluegill from both watersheds were similar. However, zinc concentrations in the fillet of all fish were found to be greater than concentrations reported in the literature for uncontaminated waters while copper concentrations in the fillet corresponded well to values in the literature. Copper and zinc concentrations were higher in carp liver than values reported in the literature and when compared to liver concentrations from bass and bluegill in this report.
W80-02410

IMPACT OF WESTERN COAL MINING - II. MICROBIOLOGICAL STUDIES,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. J. Olson, S. C. Turbak, and G. A. McFeters.
Water Research, Vol 13, p 1033-1041, 1979. 2 Fig, 4 Tab, 36 Ref. OWRT A-108-MONT(2).

Descriptors: *Sulfur bacteria, *Thiobacillus ferrooxidans, *Acid mine water, Strip mines, Mine drainage, Mine water, Mine wastes, Cytological studies, Coal mines, Hydrogen ion concentration, Montana, Carbonates, Tracers, Decker(Mont), Northeastern Wyoming.

The occurrence and activity of certain groups of sulfur cycle bacteria associated with waters, sediments, and the coal bearing strata of a coal strip mine at Decker, Montana, were studied. Mining areas in northeastern Wyoming were also examined. Thiobacillus ferooxidans, one of the major contributors to acid mine drainage, was consistently detected in the mining environment. Physiological studies of T. ferrooxidans isolates indicated that these acidophilic iron and sulfur oxidizing organisms were typical of the species in their preference for low pH and ability to oxidize pyrite. Since (1) acidic conditions were not observed at Decker, (2) the organisms did not multiply in mine water environments and (3) no acid could be formed from coal samples inoculated with a T. ferrooxidans isolate, it was thought that their activity was limited to microzones in the coal bearing strata where they oxidized sulfuritic material. Any acid formed was quickly neutralized by mineral carbonates associated with the groundwaters and overburden. Sulfate reducing bacteria also were common in the mine waters and sediments. These organisms were particularly active in the sedimentation pond sediments as was evidenced by the rapid rate of conversion of radio-labeled sulfate to sulfide. The hydrogen sulfide produced by these organisms contributed to heavy metal precipitation in the sedimentation pond. (Deal-EIS)
W80-02416

TRACE METAL CONCENTRATIONS IN SELECTED BIOLOGICAL, SEDIMENT, AND WATER COLUMN SAMPLES IN A NORTHERN NEW ENGLAND RIVER,
Academy of Natural Sciences Philadelphia, PA. Div. of Limnology and Ecology.
S. L. Friant.
Water, Air, and Soil Pollution, Vol 11, p 455-465, 1979. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Baseline studies, *Metals, *Absorption, Freshwater fish, Mollusks, Benthic fauna, Rivers, Aquatic plants, Water chemistry, Copper, Lead, Zinc, Mercury, Heavy metals, Chemical analysis, Bioindicators, *Tissue analysis, *Bioaccumulation, Maine, Kennebec River.

Analyses of metal concentrations in fish, mollusks and macrophytes from the Kennebec River present a good data base with which to compare the results of future work for the biological accumulation of metals. Analyses were also conducted on the water column and sediments to further enhance this study and to place values obtained for the biological specimens in proper perspective. Bottom-dwelling mollusks and rooted plants tend to accumulate metals found in the sediments and, in this study, metal concentrations in mollusks and plants greatly exceeded the values in sediments, fish and the water column. Concentrations of Cu, Pb and Zn were highest in plants, followed by mollusks and fish. Chromium values for mollusks were higher than those for plants and fish, while Hg values for mollusks were comparable to those for fish. Mollusks are apparently good accumulators of heavy metals and may provide long term indicators of general water quality. The levels of heavy metals found in this study suggest that rooted aquatic plants might be useful as indicators of metal contamination of a water system. It also suggests that with more intensive sampling of plant communities it may be possible to compare impact and reference stations by aquatic plant analysis along with sediments. (Deal-EIS)
W80-02417

EFFECTS OF CHLORINATED ORGANICS FROM WASTEWATER TREATMENT ON ALGAL GROWTH,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
M. S. Simmons, and K. Sivaborvorn.
Bulletin of Environmental Contamination and

Toxicology, Vol 23, p 766-773, 1979. 4 Tab, 17 Ref.

Descriptors: *Algae, *Growth rates, *Inhibition, *Chlorination, Sewage effluents, Waste water treatment, Chlorine, Chlorella, Anabaena, Bioassay, Toxicity, Organic wastes, Phytoplankton.

This study has shown that the major contribution for the growth inhibition of algae in the receiving waters of wastewater treatment plants can be attributed to the total residual chlorine in the effluents. It is also suggested that upon removal of the residual chlorine, the inhibitory effects could be due to the chloro-organic compounds which are produced during the chlorination treatment of the effluents. Extrapolations of the results of this study to the natural environment need to consider that the contents of the effluents change during short time intervals and that the natural algal population in the receiving waters consists of diverse species. (Deal-EIS)
W80-02420

ACUTE TOXICITY OF TWO MOLLUSCICIDES, MERCURIC CHLORIDE AND PENTACHLOROPHENOL TO A FRESHWATER FISH (CHANNA GACHUA),
Marathwada Univ., Aurangabad (India). Dept. of Zoology.
M. M. Hanumante, and S. S. Kulkarni.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 725-727, 1979. 1 Tab, 14 Ref.

Descriptors: *Bioassay, *Toxicity, *Molluscicides, Commercial fish, Mercury, Chlorides, Sodium compounds, Pesticide toxicity, Snails, Mortality, Fish physiology, *Channa, *Sodium pentachlorophenate.

Mercuric chloride and sodium pentachlorophenate (NaPCP) are commonly used molluscicides in curbing the population of freshwater vector snails which transmit the trematode larvae that are of medical and economic importance. As an effluent, HgCl2, and because of its use as a broad spectrum biocide, NaPCP, contaminate the water bodies throughout the world and thereby act as toxicants for extra-molluscan biota. The toxic effects of these two compounds was evaluated in the important food fish, Channa gachua. Static bioassays were performed on adult fish and LC50 values determined for 24, 48, 72 and 96 hours for each compound. These LC50 values demonstrate that NaPCP is more deleterious than HgCl2. Also, it shows that both these molluscicides lack specificity and can pose a threat to environmental health. (Deal-EIS)
W80-02421

SOURCE OF MERCURY IN FISH IN NEW IMPOUNDMENTS,
Southern Illinois Univ., Carbondale. Dept. of Chemistry and Biochemistry.
J. A. Cox, J. Carnahan, J. DiNunzio, J. McCoy, and J. Meister.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 779-783, 1979. 2 Tab, 9 Ref.

Descriptors: *Mercury, *Path of pollutants, *Reservoirs, Heavy metals, Absorption, Fish physiology, Food chains, Bass, Sunfishes, Bottom sediments, Water pollution sources, Impoundments, Illinois, Cedar Lake, *Tissue analysis, *Biomagnification.

That high levels of mercury are often found in fish flesh in new impoundments is well-known; however, the source(s) of the mercury is typically not identified. Fish from a recently constructed reservoir were analyzed for mercury content using flameless atomic absorption spectrometry. As expected, species which were high in the food chain contained more mercury as a result of biomagnification through the food chain. The data indicate that the mercury entered the food chain from the soil which was inundated when the impoundment was constructed. A subsequent conclusion is that within a few years the mercury levels in fish should be normal. (Deal-EIS)
W80-02424

UTILIZATION OF BACTERIAL COLONY COUNTERS TO COUNT EARLY INSTAR WATER FLEAS (DAPHNIA MAGNA),
EG and G Bionomics, Wareham, MA. Aquatic Toxicology Lab.
G. A. LeBlanc.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 837-839, 1979. 1 Tab, 7 Ref.

Descriptors: *Research equipment, *Analytical techniques, *Daphnia, Laboratory equipment, Bioassay, Testing procedures, *Methodology, Aquatic populations, Evaluation, Growth stages.

Chronic toxicity studies utilizing the water flea have proven to be a valuable tool in estimating safe levels of potential toxicants in the aquatic environment. Due to the small size of the animals and the large number of animals which must be counted (up to 70,000 per test), this task can be very tedious with a high error potential if counting is done manually. Experiments were performed to evaluate the accuracy of a bacterial colony counter adapted to count early instar Daphnia magna. Accuracy was tested by multiple manual counting of test groups. The error potential of the automatic counter was under 2% for small groups, but increased with the size of the group. It was concluded that this error potential was smaller than that of the manual counting method in addition to taking half the time required in manual counting. It was recommended that small groups (less than 125) be used to minimize error. (Deal-EIS)
W80-02426

HEAVY METAL CONTENTS IN COASTAL WATER FISHES OF WEST MALAYSIA,
Nebraska Univ., Lincoln. Dept. of Food Science and Technology.
A. S. Babji, M. S. Embong, and W. W. Woon.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 830-836, 1979. 4 Tab, 23 Ref.

Descriptors: *Baseline studies, *Heavy metals, *Commercial fish, Pollutant identification, *Mercury, *Lead, *Zinc, *Cadmium, Path of pollutants, Industrial wastes, Chemical analysis, Public health, *Malaysia, *Tissue analysis, *Bioaccumulation.

This study was aimed at examining the contents of zinc, lead, cadmium, and mercury in fishes caught around the coastal waters of West Malaysia. The areas chosen differ in hinterland industrial development, consisting mainly of ports, shipping, oil refineries, and miscellaneous small manufacturing industries in the west and south and basically non-industrialized areas in the north and east of peninsular Malaysia. The overall means for cadmium range from 0.03-0.05 ppm; lead, 0.21-0.32 ppm; zinc, 2.3-6.5 ppm; and mercury, 0.08-0.10 ppm. All these levels were found to be below the maximum permissible limits set by the U. S. Food and Drug Administration. Location of sampling was found to play a role in heavy metal accumulation. Concentrations were higher in industrial regions as compared to agricultural areas. Significant variance in heavy metal content between fish species was noted for all metals except mercury. (Deal-EIS)
W80-02427

AN ANALYSIS OF FEEDING RELATIONSHIPS AMONG ESTUARINE FISHES RAISED IN POLYCULTURE IN PONDS RECEIVING THERMAL EFFLUENTS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
M. R. Branch, and K. Strawn.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors Allanhald and Osmun & Co., Montclair, New Jersey, p 29-41, 1979. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Fish farming, *Thermal pollution, *Powerplants, Aquiculture, Productivity, Growth rates, Commercial fish, Mullets, Drums, Fish management, Fish diets, Heated water, Cooling water, Water temperature, *Atlantic croaker, *Micropogon.

Three species of estuarine fish were raised in 0.1 ha ponds from August 1976 to May 1977. These ponds received a continuous flow of thermal effluents. Black drum, Pogonias cromis, and Atlantic croaker, Micropogon undulatus, were each raised in polyculture with striped mullet, Mugil cephalus. All three species were also maintained in monoculture. All fish were fed a supplemental ration at rates based on body weight and their observed utilization of feed. Survival, growth rates, food conversion, and competition values were computed. At termination of this study, the size and composition of naturally occurring populations of macrofauna, other than stocked species, were estimated for each pond. These estimates along with other growth data were used to analyze the feeding relationships which occurred among species in polyculture and to determine whether such relationships might prove beneficial in terms of growth and production. Growth of all species was improved in polyculture. Increased growth among fishes in polyculture was attributed to more complete utilization of natural food resources and a facilitated feeding response due to fish-to-fish attraction. Food conversion values also indicated increased consumption of natural foods by fish maintained in polyculture. Flow of heated water into these ponds during the cool season was a critical factor governing the growth of these fish. (Deal-EIS)
W80-02433

PILOT-SCALE SYSTEMS FOR THE CULTURE OF LOBSTERS IN THERMAL EFFLUENT,
San Diego State Univ., CA. Dept. of Biology.
J. M. Carlberg, J. C. Van Olst, and R. F. Ford.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun & Co., Montclair, New Jersey, p 69-78, 1979. 3 Fig, 11 Ref.

Descriptors: *Lobsters, *Aquiculture, *Thermal pollution, Heated water, Powerplants, Cooling water, Water temperature, Growth rates, Productivity, Toxicity, Mortality, Cost analysis, Heavy metals, Animal metabolism, Commercial shellfish.

This paper reviews the recent progress made in the San Diego University aquaculture program to develop commercially viable lobster culture in the United States. It summarizes work on the evaluation of the use of thermal effluent in the culture of the American lobster, Homarus americanus, and on the development of techniques for the culture of this species. Studies show that there appear to be no detrimental effects of potentially toxic chemicals, such as heavy metals or chlorinated hydrocarbons, in the use of thermal effluents in lobster culture. The levels of excretion and acute toxicity for the metabolites secreted by the culture organism have been determined and can now be controlled. The influence of constant and fluctuating elevated temperatures on growth and survival has been measured. The development of prototype production modules for the intensive individual rearing of lobsters is discussed. Related problems on broodstock development, communal rearing of juvenile stages, formulation of artificial pelletized diets, and estimates of production costs are presented. (Deal-EIS)
W80-02434

BIOLOGICAL AND RADIOLOGICAL ANALYSIS OF THE POTENTIAL OF NUCLEAR POWER PLANT EFFLUENT WATERS FOR SHELLFISH CULTURE,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
R. A. Lutz, and C. T. Hess.
In: Power Plant Waste Heat Utilization in Aquaculture, B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun & Co., Montclair, New Jersey, p 109-138, 1979. 18 Fig, 4 Tab, 53 Ref.

Descriptors: *Shellfish farming, *Thermal pollution, *Powerplants, Mussels, Oysters, Commercial

Shellfish, Heated water, Cooling waters, Water temperature, Nuclear powerplants, Growth rates, Mortality, Radioisotopes, Absorption, Path of pollutants, Radiochemical analysis, Cobalt radioisotopes, *Tissue analysis, *Bioaccumulation, *Depuration, *Manganese radioisotopes, *Cesium radioisotopes.

Over the past five years, two species of commercially important shellfish (Mytilus edulis L. and Crassostrea virginica Gmelin) have been experimentally rafted at varying distances from the heated effluent waters of a nuclear power reactor. Two distinct effluent system designs, surface outflow (1973 to May 1975) and subsurface diffuser (July 1975 to 1978), are compared and contrasted with regard to their potential for cultivation of these bivalves. Interspecific comparisons are made of growth and survival, as well as the uptake and retention of gamma-ray-emitting radionuclides by these filter-feeding molluscs. From 1973 through 1975, cumulative shell growth of Crassostrea virginica was generally negatively correlated with distance from the heated outflow, reaching a minimum at the control site in an adjacent estuary. Oyster mortalities at all experimental sites were less than 5% and not significantly different from those encountered at the control site. In contrast, growth rates and survival of Mytilus edulis from 1973 through 1974 were generally positively correlated with linear distance from the effluent, reaching maximum values at two control localities within adjacent estuaries. After installation of the diffuser system, growth and survival of Mytilus at all experimental sites, while significantly greater than that encountered directly in outflow waters during previous years, remained low relative to control stations. (Deal-EIS)
W80-02436

DISEASONAL WASTE HEAT AQUACULTURE: A THREE-YEAR REVIEW,
Trenton State Coll., NJ. Dept. of Biology.
A. F. Eble, N. E. Stolpe, M. C. Evans, N. DeBlois, and T. Passanza.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun & Co., Montclair, New Jersey, p 139-158, 1979. 10 Fig, 9 Tab, 25 Ref.

Descriptors: *Aquiculture, *Powerplants, *Thermal pollution, Heated water, Water temperature, Cooling waters, Rainbow trout, Eels, Growth rates, Fish farming, Shellfish farming, Productivity, Seasonal, *Prawns, *Macrobrachium.

A research team was formed in 1974 to investigate the potential of culturing animals in the waste heat effluents of a fossil fuel electric generating station in Trenton, N.J. The research mission was to explore the biological feasibility and economic potential of culturing to market size Macrobrachium rosenbergii during one-half of the year (May to October) and rainbow trout for the other six months. Further, other species were to be evaluated as possible additions to the number of cultured animals. Macrobrachium rosenbergii. In order to increase total surface area of ponds, netting was draped in 'M'-shaped configurations approximately 30cm apart. Regardless of stocking densities (19 to 27 prawns/sq m)., harvest yields ranged from 11 to 16 animals/sq m (20g average size): calculated solely on bottom surface area, harvest yields were 32 sq m, which is three times more productive than present harvest yields using extensive farming techniques. Salmo gairdneri. Our aquaculture system previously had to employ intermittent flows to raceways due to power plant chlorination cycles; this resulted in low dissolved oxygen and high ammonia levels during periods of pump shutdown. A new method has been designed and is presently operating that utilizes a reservoir through which water can be recirculated to bypass power plant discharge water when chlorine programs are operating. (Deal-EIS)
W80-02437

ON FISH CULTURE AND ON THE USE OF HEATED EFFLUENTS IN POLAND,
Instytut Rybactwa Srodladowego, Zabieniec (Poland). Pond and River Dept.
T. Backiel.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun and Co., Montclair, New Jersey, p 215-230, 1979. 8 Fig, 2 Tab, 19 Ref.

Descriptors: *Fish farming, *Thermal pollution, *Powerplants, Aquiculture, Heated water, Cooling water, Carp, Salmonids, Pikes, Freshwater fish, Fish management, Commercial fish, *Poland.

This paper presents information on cultivated fishes and their relative significance in Polish inland fisheries. The main cultivation systems and some recent technical innovations are discussed. Carp is currently the most important fish cultivated in Poland, comprising 45% of the total market. Less frequently cultivated species include pikes and various salmonids. Three concepts on the use of heated effluents from power stations are exemplified: a system of production of cold- and warm-water fishes at one farm; the utilization of heated lake water for fish production; and warm-water cage culture. (Deal-EIS)
W80-02438

WASTE HEAT AQUACULTURE IN THE UNITED KINGDOM--A GENERAL REVIEW AND PARTICULARS OF MARINE FARM LTD., HINKLEY POINT, BRIDGWATER, SOMERSET, ENGLAND,
Marine Farm Ltd., Bridgewater (England).
M. V. Ingram.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian., C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun and Co., Montclair, New Jersey, p 231-234, 1979. 1 Tab.

Descriptors: *Aquiculture, *Heated water, *Nuclear powerplants, Powerplants, Thermal pollution, Cooling waters, Fish farming, Eels, Shellfish farming, Oysters, Commercial shellfish, Commercial fish.

The current state of various warm-water effluent fish farm projects in the United Kingdom are reviewed. Special reference is made to the efforts of Marine Farm Ltd. at the Hinkley Point nuclear powerplant complex. Here heated effluent is used in the culturing of eels from elvers and oyster seed from spat. Various technical problems encountered in the culture system are discussed and remedies presented. (Deal-EIS)
W80-02439

DIRECT USE OF COOLING AND BLOW-DOWN WATER FOR INTENSIVE FISH FARMING RESULTS OBTAINED IN A PILOT FACILITY AT THE NIEDERAUSSEM POWER PLANT,
Rheinisch-Westfaelishches Elektrizitaetswerk A.G., Essen (Germany, F.R.). Abt Anwendungstechnik.
K. Blank.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun and Co., Montclair, New Jersey, p 235-242, 1979. 7 Fig.

Descriptors: *Fish farming, *Heated water, *Powerplants, Aquiculture, Water temperature, Carp, Eels, Cooling waters, Thermal pollution, Fish management, Growth rates, Productivity, Fish diseases.

RWE is the largest private-sector power supply utility in West Germany and generates 35% of the country's electricity needs. In 1974 it decided to examine the practical possibilities of using process water for the farming of freshwater fish. The results so far show that both the cooling water and the blow-down water from this lignite-fired power plant are suitable for fish culture. In both types of water the growth for carp was four times, and for eel five times, that in conventional fish culture. Stocking densities of 1:10 are attained for carp and 20 to 25 kg/sq m for eel. Industrial fish farming, which is in its early days in West Germany (two other facilities are operating on heated surface water), faces the following problems: (a) cleaning waste water economically for fish farming, (b) obtaining a season-independent fish stock, and (c) preventing disease in the fish. (Deal-EIS)
W80-02441

RELATIONSHIPS OF ACTIVITIES OF METAL-LIGAND SPECIES TO AQUATIC TOXICITY,
Minnesota, Univ.-Duluth. Dept. of Chemistry.
V. R. Magnuson, D. K. Harriss, M. S. Sun, D. K. Taylor, and G. E. Glass.
In: Chemical Modeling in Aqueous Systems, E. A. Jenne, Ed., American Chemical Society, Symposium Series, No 93, p 635-656, 1979. 2 Fig, 10 Tab, 15 Ref.

Descriptors: Metals, *Copper, Water pollution effects, *Toxicity, Bioassay, Laboratory tests, Methodology, Daphnia, Water quality, Chemical analysis, *Chemical properties, Chemical reactions, Metal-ligand species, Copper species, Chemical activity, Copper carbonate, Copper complexes, Free copper.

The use of factor analysis and multiple regression in determining relative toxicities of species is described. Procedures are illustrated using the data of Andrew, Biesinger and Glass from a study of toxicity of copper to Daphnia magna following a recalculation of the equilibrium speciation of copper. The results yield tentative conclusions that the carbonate copper complexes are not toxic, the anionic hydroxo copper complexes contribute 15-18% to the toxicity of copper, and that free copper and/or the neutral and/or cationic hydroxo copper complexes are responsible for 60-70% of the toxicity in this set of experiments. The limitations of this analysis are discussed and a set of experiments which should provide more definitive answers to the relative toxicity of these species is described. (Katz-EIS)
W80-02444

ENVIRONMENTAL EFFECTS OF OIL SHALE MINING AND PROCESSING PART III - THE WATER QUALITY OF PICEANCE CREEK, COLORADO, PRIOR TO OIL SHALE PROCESSING,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
R. K. Skogerboe, C. S. Lavallee,, M. M. Miller, and D. L. Dick.
Environmental Protection Agency, Report EPA 600/3-79-055, May 1979. 59 p, 22 Fig, 7 Tab, 12 Ref, Append.

Descriptors: *Metals, *Oil, Mining, *Mineral industry, Monitoring, Water quality, Water chemistry, Colorado, Piceance Creek, Piceance Basin, Steward Creek, Black Sulphur Creek, Yellow Creek, *Oil shale, Dissolved solids, Manganese, Iron, Groundwater, Copper, Zinc, Arsenic, Selenium, Mercury.

Water quality data have been collected at seven sites along Piceance Creek and at one site each along Stewart, Black Sulphur, and Yellow Creeks in the Piceance Basin, Colorado, during 1975-1977. Piceance, Stewart, and Yellow Creeks may be perturbed by oil shale industry activities on the two tracts, C-a and C-b, currently under development. The preoperational water quality is generally poor due to higher levels of dissolved solids, manganese, and both dissolved and suspended iron. It further declines farther downstream primarily due to influxes from groundwater aquifers in contact with soluble mineral beds. The levels of aluminum, cadmium, chromium, lead, and boron were below the detection limits of the analysis method used. These were typically below the permissible levels set for aquatic life by factors of 5-10. The levels of copper, zinc, arsenic, selenium, and mercury were usually measurable but still below permissible. Equilibrium calculations indicate that the natural conditions along Piceance Creek--in particular the alkaline pH range (7.5-8.5) and high carbonate alkalinity (300-800 mg CaCO3/liter)-should limit the solubilities of most metals to levels below the standards for aquatic life. (Katz-EIS)

W80-02445

AN ASSESSMENT OF THE THERMAL EFFECTS ON STRIPED BASS LARVAE ENTRAINED IN THE HEATED DISCHARGE OF THE INDIAN POINT GENERATING FACILITIES UNITS 2 AND 3,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
H. H. Carter, R. E. Wilson, and G. Carroll.
Special Report 24, Reference 79-7, June 1979. 33 p, 21 Fig, 1 Tab, 21 Ref.

Descriptors: *Nuclear powerplants, *Heated water, *Toxicity, *Striped bass, Larval growth stage, Entrainment, Mathematical models, Cooling water, Thermal pollution, Water temperature, Mortality, Thermal stress, Estuaries, Lethal limit, New York, Hudson River.

In this report there is modelled the excess temperature and velocity fields associated with the heated discharge from a large generating station sited on a tidal estuary using the model, together with appropriate thermal resistance data, thermally induced mortality levels of striped bass post yolk sac larvae entrained in the thermal plume are evaluated. The model consists of separate near-field and far-field portions which were combined to form a complete-field model by vector addition of the velocity fields and by superposition of the excess temperature fields based on a simple mixing concept. By calculating and storing velocity and excess temperature fields appropriate to each of 20 different phases of the tide, a complete-field model followed, The thermal dose experienced by an assumed initial distribution of passive organisms where the receiving water velocities are time varying, such as occurs in a tidal estuary or coastal setting, as well as unidirectional is calculated. For this reason it is considered quasi-transient state. The model further suggests that the zone of influence or withdrawal of the intakes is limited to 20-30 meters in the lateral direction. (Deal-EIS)
W80-02446

NOTE ON RAPID AND SENSITIVE METHOD FOR THE DETERMINATION OF ANIONIC DETERGENTS IN NATURAL WATERS, AT THE PPB LEVEL,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W80-02465

GROWTH RESPONSE OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREBISSON IN WATERS COLLECTED FROM LONG LAKE RESERVOIR, WASHINGTON,
Corvallis Environmental Research Lab., OR.
T. Shiroyama, W. E. Miller, J. C. Greene, and C. Shigihara.
In: Proceedings of the Symposium on Terrestial and Aquatic Ecological Studies of the Northwest, Eastern Washington State College, Cheney, Washington, March 26-27, 1976, EWSC Press, Cheney, p 267-275, 1976. 4 Fig, 1 Tab, 11 Ref.

Descriptors: Algae, *Phytoplankton, *Nutrients, Washington, Long Lake, Spokane River, Long Lake Reservoir, Bioassay, Anabaena, *Phosphorous compounds, Plant growth, Plant physiology, Zinc, Orthophosphates, Laboratory tests, Domestic wastes, Chelating agents, EDTA.

Effluent from the Spokane primary sewage treatment plant and heavy metal contaminants from the Coeur d'Alene Lake watershed have been major water quality problems in the Spokane River and Long Lake Reservoir. Using the Algal Assay Procedure: Bottle Test, waters collected from the reservoir were used to measure the growth response of a filamentous nitrogen-fixing blue-green alga, Anabaena flos-aquae. Predicted algal yields based on chemical analysis of the test waters for orthophosphorus, indicated that only 28% of the Anabaena cultures produced optimal growth. There was a substantial increase in response when the test waters were spiked with an EDTA chelator-thus indicating the presence of heavy metals. The influences of heavy metals were more prominent during the high flows of spring and fall. When the heavy metal toxicity was overcome by chelation, phosphorus was found to be the primary growth limiting nutrient for support of Anabaena flos-aquae. (Katz-EIS)
W80-02475

BIOASSAYS RELATED TO THE EFFECTS OF COAL STRIP MINING AND ENERGY CONVERSION ON THE AQUATIC MICROFLORA,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. Olson, S. Turbak, and G. McFeters.
In: Proceedings of the Symposium on Terrestial and Aquatic Ecological Studies of the Northwest. Eastern Washington State College, Cheney, Washington, March 26-27, 1976, EWSC Press, Cheney, p 227-283, 1976. 2 Fig, 2 Ref.

Descriptors: *Bioassay, *Algae, *Copper, Laboratory test, *Toxicity, Coal mines, Coal mine wastes, Strip mines, *Strip mine Wastes, Montana, Decker, Colstrip, Algal assay procedure, Selerastrum, Metals, Phosphorous, Coal, Leachates.

The practice of strip mining for coal has been intensified in many Western states recently. Specific microbial bioassays for the detection of inhibitory or stimulatory compounds which may be present in the aquatic environment due to coal mining and related energy conversion activities were developed. The waters under investigation are located in the Decker and Colstrip regions of southeastern Montana. Results from the Algal Assay Procedure: Bottle Test (AAP) have indicated that the surface waters studied at Decker are primarily phosphorus limited. Our results have also shown no heavy metal toxicity or trace element deficiency in these waters at the present time. We are currently using microorganisms isolated from waters in the affected areas to test coal leachates for presence of possible toxic materials in addition to monitoring the surface waters in the affected areas using the AAP. The green alga, Selenastrum capricornutum Printz, although not indigenous to these areas, shows potential for use as a bioassay organism. In an experiment with copper, for example, 0.0 to 0.4 ppm (of Cu++ added as CuS04. 5H20) added to the growth medium resulted in a steady decline in growth rate. (Deal-EIS)
W80-02476

METABOLIC ACTIVITY OF BACTERIA IN THE RIVER DANUBE IN A YEAR CYCLE,
Institute of Experimental Biology and Ecology, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 5C.
W80-02504

ESCHERICHIA COLI BACTERIOPHAGES AS TRACERS IN WATER MOVEMENT STUDIES,
Helsinki Univ. (Finland). Dept. of Microbiology.
K. Kinnunen, S. Niemela, and M. Poikolainen.
In: Proceedings: Congress in Denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2272-2277. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Tracers, *Marking techniques, *E. coli, *Discharge measurement, *Discharge(Water), *River flow, Indicators, Analytical techniques, Movement, Tracking techniques, Bioindicators, Flow, Velocity, Chezy equation, Kymi River(Finland), Vantaa River(Finland), Time, Distance, Bacteria, Rivers, Microbiology, Sewage bacteria.

Bacteriophagic tracers are practical in studying river water flows; in Finnish experiments the largest tracer volume was 5000 ml, longest distance measure, 62 km, and greatest discharge 574 cu m/sec. Phage tracers are environmentally harmless; this is not true of radioactive isotopes. Due to phage host specificity, several different phages can be used simultaneously as tracers, permitting travel velocity studies of entire water courses. The greatest disadvantage of this method is that separate phage samples must be taken and cultivated in the laboratory. However, results can be read 4-6 hours after cultivating which is quick compared to other microbiological tracer methods. Marking studies on water travel speed in the Kymi River occurred in 1968, 1970, and 1975; discharge varied 258-574 cu m/sec. Nearly perfect linear correlation (r=0.9997) observed between Kymi discharge and velocity is taken as proof of the value of phage methods. In the Vantaa River, four different phages were used simultaneously in a marking experiment. Tracer waves reached the sampling site partly overlapping, but they were identified from the same samples through cultivation. (Danovich-Wisconsin)
W80-02509

CARBON ANALYSIS FOR THE DETERMINATION OF INDIVIDUAL BIOMASSES OF PLANKTONIC ANIMALS,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
For primary bibliographic entry see Field 5C.
W80-02551

TRACE METAL ION FILTRATION LOSSES AT PH 5 AND 7,
New Hampshire Univ., Durham. Dept. of Chemistry.
R. E. Truitt, and J. H. Weber.
Analytical Chemistry, Vol 51, No 12, p 2057-2059, October 1979. 2 Tab, 22 Ref. OWRT B-004-NH(2), 14-34-0001-8132.

Descriptors: *Copper, *Ion movement, *Filtration, *Membranes, *Ion transport, Hydrogen ion concentration, Separation techniques, Leaching, Trace elements, *Polycarbonate filter supports, *Glass filter supports, *Nucleopore polycarbonate membrane, *Cellulose triacetate membrane, *Copper filtration losses, Metal ion concentrations, Ion filtration losses.

The purpose of this experiment was to point out changes in metal ion concentrations that occur from filtering solutions with pH and metal ion levels similar to many natural water systems. Acetate buffer or phosphate buffer was filtered using cellulose acetate or polycarbonate membranes on polycarbonate support. Slight contaminations of Cu2+ and Pb2+ occurred. Cu2+ and Pb2+ leached from both membranes at pH 5 and 7. Percentage Cu2+ losses were then determined as a function of filter support, filter membrane and pH and greatest losses occurred using glass support. Losses with polycarbonate support were insignificant except for filtering with a cellulose acetate membrane. Cu2+ losses with polycarbonate membranes were 35% whereas losses with cellulose acetate membranes were 18%. Average Cu2+ loss of glass support/polycarbonate membrane and polycarbonate support/cellulose acetate membrane combinations was 39% compared to 14% for glass/cellulose acetate and polycarbonate/polycarbonate combinations. Varying pH had little effect on Cu2+ losses.
W80-02600

EPIPHYTIC DIATOMS OF THREE SEAGRASS SPECIES IN MISSISSIPPI SOUND,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
M. J. Sullivan.
Bulletin of Marine Science, Vol 29, No 4, 459-464, October 1979. 3 Tab, 11 Ref. OWRT A-114-MISS(2), 14-34-0001-8026.

Descriptors: *Diatoms, *Rooted aquatic plants, *Sessile algae, *Biological communities, Ecological distribution, Biogeography, Marine algae, Submerged plants, Aquatic habitats, Mississippi, *Scanning electron microscope, *Epiphytic algae, *Seagrasses, Community diversity, Horn Island(Miss Sound), Halodule, Cymodocea(=Syringodium), Thalassia.

Epiphytic diatoms were collected on 20 July 1977 from the leaves of three seagrass species (Halodule beaudettei, Cymodocea filiforme, and Thalassia testudinum) in Mississippi Sound, U.S.A. Examination of cleaned material under the light and scanning electron microscope revealed a total of 45

diatom taxa epiphytic on the three seagrasses. The four most abundant diatoms were Fragilaria hyalina, Mastogloia pusilla, Licmophora cf. debilis, and Opephora pacifica. Except for the rare taxa, the taxonomic composition was identical regardless of the seagrass species examined. Based on counts of 1,000 valves, values of community diversity statistics (H', S, and R') were virtually identical for the three epiphytic diatom samples. Use of a selected similarity index (SIMI) revealed that any two samples shared between 82 and 88% of the maximum similarity possible. Therefore, the available taxonomic and structural information indicated that the above three seagrasses supported a single, nearly homogeneous epiphytic diatom community at the time of sampling and in the locality sampled. (Sullivan-Mississippi)
W80-02602

ASSOCIATION OF HYDROPHOBIC ORGANIC COMPOUNDS WITH DISSOLVED ORGANIC MATTER IN AQUATIC SYSTEMS,
Wisconsin Univ.-Madison. Water Chemistry Program.
J. P. Hassett, and M. A. Anderson.
Environmental Science and Technology, Vol 13, No 12, p 1526-1529, December 1979. 6 Fig, 1 Tab, 11 Ref. EPA R00514201.

Descriptors: *Pollutant identification, *Testing procedures, Methodology, *Wisconsin, *Aquatic environment, Organic compounds, Organic matter, Polychlorinated biphenyls, Chromatography, Rivers, Cholesterol, Water, Ultraviolet radiation, *Menomonee River(WI).

Radiolabeled cholesterol added to water samples was recovered less efficiently from river water than from distrilled water by solvent extraction. However, if organic matter in river water was destroyed with UV radiation prior to cholesterol addition, recovery was equivalent to that from distilled water. This demonstrated that cholesterol could be bound by dissolved organic matter and stabilized in the aqueous phase. Water samples containing radiolaveled cholesterol or the PCB isomer 2,2',5,5' -tetrachlorobiphenyl were fractionated by gel permeation chromatography. Results indicated that these compounds were associated with high molecular weight organic matter present in the samples. (Humphreys-ISWS)
W80-02681

AN EVALUATION OF COLUMN CHROMATOGRAPHY AND FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY FOR ARSENIC SPECIATION AS APPLIED TO AQUATIC SYSTEMS,
Wisconson Univ.-Madison. Water Chemistry Program.
D. G. Iverson, M. A. Anderson, T. R. Holm, and R. R. Stanforth.
Environmental Science and Technology, Vol 13, No 12, p 1491-1494, December 1979. 1 Fig, 1 Tab, 31 Ref. USEPA R-804-881, DACW23-77-C-0046.

Descriptors: *Testing procedures, *Arsenic, *Water analysis, *Analytical techniques, Speciation, Methodology, Spectrophotometry, Chromatography, Laboratory tests, Chemical analysis, Sampling, Water sampling, Aquatic environment, Rivers, Pore water, Atomic absorption,.

Flameless atomic absorption (FAA) and chromatographic methods for routine analysis and speciation of environmental arsenic were presented. Matrix modification with Ni(NO3)2 was used with FAA to measure As concentrations in river water and sediment samples. Detection limits were 2 micrograms of As/L and FAA response for As concentration was independent of As species. Inorganic As (As(V) and As(III)), mono-methylarsonic acid (MMAA), and dimethylarsinic acid (DMAA) were separated on cation exchange columns and detected by FAA. These methods were applied to samples collected from the Menominee River, Wisconsin, where As contamination has resulted in As levels ranging from 1 to 1000 micrograms/L in river water, from 10 to 7000 mg/L in sediment pore water, and from 4 to 30 mg/g in sediment solids. Field data were presented to illustrate the application of the procedures. Sampling methods and preparation were included. (Humphreys-ISWS)
W80-02682

ASSIMILATIVE CAPACITY OF SMALL STREAMS,
Parsons, Brinckerhoff, Quade, and Douglas, Inc., New York.
For primary bibliographic entry see Field 5B.
W80-02693

5B. Sources Of Pollution

WATER QUALITY EFFECTS OF LEAD FROM RECREATIONAL BOATING,
California State Coll., Stanislaus, Turlock. Dept. of Chemistry.
J. E. Byrd, and M. J. Perona.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127236, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, University of California, Davis Technical Completion Report, December 1979, 40 p, 13 Fig, 5 Tab, (California Water Resources Center Project UCAL-WRC-W-552). OWRT-A-071-CAL(1).

Descriptors: *Water quality, *Lead, *Boating, *Recreation, *Pollution, *Lakes, Heavy metals, Natural streams, California.

The temporal and spatial variations in the lead concentration of a fresh water-recreational lake were determined, and the results compared with daily records of lake volume, residence time and number of boats launched. In addition, laboratory studies were carried out to establish the influence of sediment-water interactions on the lead concentration of the lake water. The variation in the lead concentration in the main body of the lake was found to correlate with the lake volume. This fact, together with the laboratory studies and calculations based on a plug flow model, suggest that sediment-water interactions are significant in controlling the lead concentration in the main body of the lake. On the other hand, boating was found to be important in controlling the lead concentration in the boat dock area. This water is subjected to both poor mixing and heavy boat traffic. (Snyder-California)
W80-02403

THE SURVIVAL OF ENTERIC VIRUSES IN SEPTIC TANKS AND SEPTIC TANK DRAIN FIELDS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
K. E. Hain, and R. T. O'Brien.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127251, Price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, New Mexico State University, Report No 108, August 1979. 73 p, 14 Fig, 11 Tab, 55 Ref, Append. OWRT A-052-NMEX(6), 14-34-0001-9033.

Descriptors: *Septic tanks, *Water pollution sources, Groundwater movement, *Enteric virus, *Virus movement, *Virus persistance, *Drainfield soils, Poliovirus.

The persistence of enteric viruses in a functioning septic tank system was followed using poliovirus type I as a model. Poliovirus was incubated in dialysis membrane chambers suspended both in the chambers of a septic tank and in groundwater observation wells strategically placed in the adjacent drainfield. Poliovirus was also incubated, in situ, in the sandy loam drainfield soils to monitor virus movement and inactivation. Attempts were made to isolate indigenous enteric viruses from the septic tank and drainfield groundwater. Indigenous enteric viruses were regularly recovered from the septic tank. Seeded poliovirus type I survived in the septic tank environment long enough to enter the drainfield. Viruses introduced into the drainfield remained infective for extended periods and moved with groundwater flows. Poliovirus incubated in shallow groundwater was rapidly inactivated, but contact with soil seemed to have a protective effect. A consistent disagreement between the results from laboratory experiments and field studies was noted. The septic tank system used lay in the flood plain of the Rio Grande, within the Elephant Butte Irrigation District. Movement of indigenous enteric viruses through drainfield soils and into shallow groundwater during the initiation of irrigation-season river flows was reported. (Herman-New Mexico)
W80-02404

MATHEMATICAL MODEL OF HEAVY METAL TRANSFER AND TRANSPORT IN LAKE ERIE,
Bowling Green State Univ., OH. Dept. of Geology.
L. J. Walters Jr., and D. C. Drain.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127590, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Center, Ohio State University, Columbus. Project completion Report No 549x, August 1979, 141 p, 18 Fig, 7 Tab, 31 Ref, 3 Append. OWRT A-045-OHIO(1).

Descriptors: *Bottom sediments, *Deposition(Sediments), *Sediment transport, *Heavy metals, *Water pollution sources, *Lake Erie, Sedimentation rates, Suspended load, Path of pollutants, Mathematical models, *Mercury, *Chromium, *Nickel.

Numerical integration of mathematical functions representing the concentration of mercury, chromium and nickel in Lake Erie sediments indicate that 3.3 x 10 to the 5th power kg Hg, 1.8 x 10 to the 7th power kg Cr, and 1.2 x 10 to the 7th power kg Ni have been added to the sediments through man's activities. Most of the mercury, chromium and nickel are contained in the sediments of western Lake Erie. A mathematical model of sediment transport in Lake Erie shows that most of the heavy metals in western Lake Erie sediments probably originated from the Detroit metropolitan area and was input via the Detroit River. The sediment dispersal patterns are as follows: (1) the Detroit River sediment spreads southeastward over most of the western basin, (2) the Maumee River sediment is held within 15 miles of the Ohio shore, and (3) the Cuyahoga River sediment travels northeastward along the south shore of the lake. Attempts to model the transfer and transport of mercury within the ecosystem resulted in partial success. Very little transfer results between the sediments and other phases within the system. In contrast the exchange of mercury between the benthic organisms and other trophic and abiotic levels is very rapid.
W80-02407

POLIOVIRUS TYPE I REMOVAL BY MONTMORILLONITE CLAY,
California Univ., Los Angeles. Dept. of Chemical, Nuclear and Thermal Engineering.
G. L. Meronek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127210, Price codes: A03 in paper copy, A01 in microfiche. MS Thesis, 1978, 47 p, 9 Fig, 6 Tab, 2 Append. (California Water Resources Center Project UCAL-WRC-W-523). OWRT B-184-CAL(4).

Descriptors: *Viruses, *Montmorillonite, *Clays, *Waste water(Pollution), *Waste water disposal, Water pollution, Pollutants.

This study arises from the problem of underground water contamination by viruses in percolating wastewater or eluted from landspread sludge. Since current water treatment facilities are unable to completely remove viruses from wastestreams, the task of virus removal by soils is required. At present the mechanism by which viruses are removed by soils is unknown. This study attempts to obtain a better understanding of virus transport through soil beds by looking at the adsorption isotherm of poliovirus to montmorillonite clay. Clay was chosen as the adsorbent because of its extremely large surface area and because the per-

cent of clay in soil stands out as the most useful indicator of contaminant soil retention capability. The removal of poliovirus by montmorillonite clay was found to conform to a modified Freundlich isotherm. It was determined however that saturation of the clay particles was not reached so that a complete isotherm was not attained. Virus removal was found to depend on particle size and may be caused by association of the virions with aggregated clay particles. (Snyder-Cal)
W80-02408

TRACE METAL CONCENTRATIONS IN SELECTED BIOLOGICAL, SEDIMENT, AND WATER COLUMN SAMPLES IN A NORTHERN NEW ENGLAND RIVER,
Academy of Natural Sciences Philadelphia, PA. Div. of Limnology and Ecology.
For primary bibliographic entry see Field 5A.
W80-02417

EFFECT OF MERCURY ON THE MORPHOLOGY OF ERYTHROCYTES IN ANABAS SCANDENS,
Berhampur Univ., Orissa (India). Lab. of Environmental Toxicology.
A. K. Panigrahi, and B. N. Misra.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 784-787, 1979. 4 Fig, 16 Ref.

Descriptors: *Mercury, *Toxicity, *Fish physiology, Mode of action, Biological membranes, Heavy metals, Osmotic pressure, Freshwater fish, Cytological studies, Membrane processes, *Blood chemistry, *Red blood cells, *Anabas, Erythrocytes.

The purpose of this investigation was to study the effect of inorganic mercury on the morphology of erythrocytes in a freshwater fish, Anabas scandens. Fish were exposed to 0.5 mg/L of mercury as mercuric nitrate for 35 days. An enlargement of red blood cells (RBC) was observed within 7 days of exposure. After 7 days, finger-shaped proliferations were marked in the neutrophilic granulocytes of exposed fishes. Vacuoles were seen in the RBCs. Beak-like structures appeared on the RBCs after 14 days of exposure. Rupturing of RBC membrane after 28 days exposure was noticed, and in some cells disintegration of the nucleus and cell membrane was apparent. After 35 days exposure complete hemolysis and disappearance of cell membrane was seen. This affect in part explains the anemia associated with certain heavy metal poisoning. (Deal-EIS)
W80-02423

SOURCE OF MERCURY IN FISH IN NEW IMPOUNDMENTS,
Southern Illinois Univ., Carbondale. Dept. of Chemistry and Biochemistry.
For primary bibliographic entry see Field 5A.
W80-02424

HEAVY METAL CONTENTS IN COASTAL WATER FISHES OF WEST MALAYSIA,
Nebraska Univ., Lincoln. Dept. of Food Science and Technology.
For primary bibliographic entry see Field 5A.
W80-02427

MODIFICATIONS OF AN EXPERIMENTALLY POLLUTED ECOSYSTEM IN THE LAGOON OF STRUNJAN, NORTH ADRIATIC,
Marine Biological Station, Portoroz (Yugoslavia).
A. Malej, A. Avcin, J. Faganeli, N. Fanuko, and M. Lenarcic.
In: IVes journees d'etudes sur les pollutions marines en Mediterranee, Commission Internationale Pour L'Exploration Scientifique De La Mer Mediterranee, Monaco, 24-27 Novembre 1978, Antalya, Turkee, p 423-429, 1979. 3 Fig.

Descriptors: *Biological communities, *Water quality, *Sewage effluents, Benthic flora, Benthic fauna, Dominant organisms, Lagoons, Phytoplankton, Zooplankton, Water chemistry, Metals, Water pollution effects, Aquatic algae, Eutrophication, Adriatic Sea, Lagoon of Strunjan.

In order to ascertain whether changes in the marine environment and their communities were due to the effects of pollution or natural fluctuations, the experimental pollution of a lagoon was studied. Sewage wastes of known quantity and chemical composition were released daily into the lagoon and the changes in numerous environmental parameters were recorded. Significant changes were noted in all physical and chemical parameters (e.g., temperature, pH, nutrients, DO, BOD, metals, etc.). A large bloom of nitrophilic algae created temporary anaerobic conditions and altered the normal annual plant succession. Phytoplankton biomass and abundance were reduced. Changes were also noted in zooplankton and bacteria communities. (Deal-EIS)
W80-02432

PILOT-SCALE SYSTEMS FOR THE CULTURE OF LOBSTERS IN THERMAL EFFLUENT,
San Diego State Univ., CA. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W80-02434

DETERMINATION OF SALINITY SOURCES IN WATER RESOURCES OF KANSAS BY MINOR ALKALI METAL AND HALIDE CHEMISTRY,
Kansas Water Resources Research Inst., Manhattan.
D. O. Whittemore, and L. M. Pollock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-128911, Price codes: A03 in paper copy, A01 in microfiche. Contribution No 208, October 1979. 28 p, 4 Fig, 10 Tab, 15 Ref. OWRT A-089-KAN (1), 14-34-0001-8018.

Descriptors: *Oil-field brines, *Saline formations, *Freshwater, *Kansas, *Saline water, Weight ratios, Chloride concentrations, Linear zone, Alkali metal.

Certain sources of brines contaminating freshwater resources in Kansas can be differentiated by their alkali metal and halide chemistry. Oil-field brines from Kansas generally have weight ratios of Na/Cl = 0.5 plus or minus 0.1, I/Cl >20 and Br/Cl >4. No noticeable trends in the constituent ratios was observed with increasing age of the producing strata. Saline formation waters usually have Na/Cl ratios of 0.65 plus or minus 0.03, I/Cl of <10, and Br/Cl <4. Most of these are probably derived from the solution of salt. Ratios involving lithium (Li/Cl, Br/Li, and Li/I) exhibited a wider range than for the above ratios, but varied much less for a particular brine within a particular geographic area. The constituent ratios Na/Cl, I/Cl, and Br/Cl thus appear to be the best for distinguishing among different types of brines, while ratios including lithium may prove helpful in further identifying local salinity sources. One of the clearest ways to differentiate among saline sources is by a graph of I/Cl versus chloride concentration. Fresh waters, saline brines from salt solution, and mixtures of these in Kansas plot as a linear zone about the line I/Cl = 103 (Cl)-0.5, where chloride concentration is in mg/l. Oil-field brines lie in a group at higher I/Cl and chloride concentration than this zone. Fresh waters contaminated by oil-field brines would be expected to plot in the gap between the linear zone and the oil brine group.
W80-02472

GROWTH RESPONSE OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREBISSON IN WATERS COLLECTED FROM LONG LAKE RESERVOIR, WASHINGTON,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5A.
W80-02475

CHEMICAL QUALITY OF GROUND WATER ON CAPE COD, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
M. H. Frimpter, and F. B. Gay.
Geological Survey Water-Resources Investigations 79-65 (open-file report), 1979. 11 p, 6 Fig, 2 Plates, 2 Tab, 9 Ref.

Descriptors: *Water quality, *Groundwater, *Saline water intrusion, *Chemical analysis, *Water pollution sources, Sea water, Water wells, Pumping, Drawdown, Surface-Groundwater relationships, Groundwater recharge, Iron, Manganese, Nitrates, MUnicipal wastes, Insecticides, Hydrogen sulfide, Domestic wastes, Fertilizers, Massachusetts, Aquifer management, *Cape Cod.

Cape Cod is a 440 square mile hook-shaped peninsula which extends 40 miles into the Atlantic. Freshwater in Pleistocene sand and gravel deposits is the source of supply for nearly 100 municipal and thousands of private domestic wells. Most ground water on Cape Cod is of good chemical quality for drinking and other uses. It is characteristically low in dissolved solids and is soft. In 90 percent of the samples analyzed, dissolved solids were less than 100 mg/l (milligrams per liter) and pH was less than 7.0. Highway deicing salt, seawater flooding due to storms, and saltwater intrusion due to ground-water withdrawal are sources of sodium chloride contamination. Chloride concentrations have increased from 20 to 140 mg/l, owing to saltwater intrusion at Provincetown's wells in Truro. In Yarmouth, contaminated ground water near a salt-storage area contained as much as 1,800 mg/l chloride. Heavy metals, insecticides, and herbicides were not found at concentrations above the U.S. Environmental Protection Agency's recommended limits for public drinking-water supplies, but iron and manganese in some samples exceeded those limits. Ninety percent of 84 samples analyzed for nitrate reported as nitrogen contained less than 1.3 mg/l and 80 percent contained 0.5 mg/l or less of nitrate as nitrogen. Water containing nitrogen in excess of 0.5 mg/l has probably been affected by municipal or domestic sewage or fertilizer, and water with less than this amount may have been affected by them. (Woodard-USGS)
W80-02584

WATER-QUALITY INVESTIGATION OF THE FLAT BAYOU WATERSHED, JEFFERSON COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
T. E. Lamb.
Availability: OFSS, USGS Box 25425, Denver CO 80225. Microfiche $3.50, papercopy $2.50. Geological Survey open-file report 79-1300, 1979. 19 p, 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Water quality, *Surface waters, *Watershed management, *Water analysis, Chemical analysis, Land use, Topography, Water utilization, Groundwater resources, Hydrogeology, Aquifer characteristics, *Flat Bayou watershed(AR), Pre-soil conservation study.

The results of a 1-year study, in 1977-78, of surface-water quality in the Flat Bayou watershed, Jefferson County, Ark. are presented to document conditions before implementation of Soil Conservation Service programs. Analysis of samples collected at two sites showed that oxygen depletion, as low as 32 percent of saturation at times, and high concentrations of pesticides on the streambed were the most serious water-quality problems in the watershed. The pesticides aldrin, DDD, DDE, DDT, dieldrin, endrin, heptachlor epoxide, lindane, and toxaphene were found in samples of the bottom material. One sample of bottom material contained an unusually high toxaphene concentration of 160 micrograms per kilogram. (Woodard-USGS)
W80-02594

TRACING SUBTERRANEAN FLOW OF SEWAGE-PLANT EFFLUENT IN LOWER ORDOVICIAN DOLOMITE IN THE LEBANON AREA, MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.; and Missouri Dept. of Natural Resources, Rolla Div. of Geology and Land Survey.
J. Skelton, and D. E. Miller.
Ground Water, Vol 17, No 5, p 476-486, September-October 1979. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Subsurface flow, *Surface-groundwater relationships, *Sewage effluents, *Tracking techniques, Fluorescent dye, Rhodamine, Karst hydrology, Sinks, Faults(Geologic), Groundwater, Potentiometric level, Missouri, *Lebanon area(MO), Losing streams, Gaining streams.

In an area of faulted, cavernous, carbonate rocks of Ordovician age near Lebanon, Missouri, sewage-treatment-plant effluent was traced from Dry Auglaize Creek, a losing Ozark stream, to Sweet Blue and Hahatonka Springs in an adjacent basin. Rhodamine WT dye (20-percent solution) was used to trace the subsurface movement of the effluent. Activated charcoal packets and samples of water were collected at 10 sites where dye might be expected to reappear and at a control site outside the area. The leading edge of the dye reached Sweet Blue Spring, a distance of 22.5 kilometers from the injection point, 25 to 30 days after injection, and Hahatonka Spring, at a distance of 29.0 kilometers, 45 to 50 days after injection. The apparent underground travel rate, based on straight-line distances between injection and resurgence points, was 0.6 to 0.8 kilometers per day. (Woodard-USGS)
W80-02595

RECONNAISSANCE EVALUATION OF SURFACE-WATER QUALITY IN EAGLE, GRAND, JACKSON, PITKIN, ROUTT, AND SUMMIT COUNTIES, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
L. J. Britton.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, microfiche $3.50, paper copy $38.00. Geological Survey open-file report 79-420, April 1979. 285 p, 9 Fig, 41 Tab, 106 Ref.

Descriptors: *Water quality, *Colorado, *Streams, *Water polluton sources, *Evaluation, Streamflow, Water sampling, Chemical analysis, Chemical properties, Physical properties, Biological communities, *Northwest Colorado, Eagle County(CO), Grand County(CO), Jackson County(CO), Pitkin County(CO), Routt county(CO), Summit County(CO).

Water-quality data were collected from streams in a six-county area in northwest Colorado to determine if the streams were polluted and, if so, to determine the sources of the pollution. Eighty-three stream sites were selected for sampling in Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties. A summary of data collected prior to this study, results of current chemical and biological sampling, and needs for future water-quality monitoring are reported for each county. Data collected at selected sites included temperature, pH, specific conductance, dissolved oxygen, and stream discharge. Chemical data collected included nutrients, inorganics, organics, and trace elements. Biological data collected included counts and species composition of total and fecal-coliform bacteria, fecal-streptococcus bacteria, benthic invertebrates, and phytoplankton. Most of the sites were sampled three times: in April-June 1976, August 1976, and January 1977. (Woodard-USGS)
W80-02597

ENVIRONMENTAL POLLUTION FROM HIGHWAY DEICING COMPOUNDS,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5C.
W80-02657

ACID PRECIPITATION: MEASUREMENT OF PH AND ACIDITY,
Virginia Univ., Charlottesville, Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W80-02667

ACIDIFICATION AND OTHER CHEMICAL CHANGES IN HALIFAX COUNTY LAKES AFTER 21 YEARS,
Fisheries and Marine Service, Halifax (Nova Scotia).
For primary bibliographic entry see Field 2K.
W80-02668

WATER AND NUTRIENT TRANSPORT VIA GROUNDWATER FROM WARD VALLEY INTO LAKE TAHOE,
California Univ., Davis. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W80-02669

GROUNDWATER QUALITY NEAR AN UNDERGROUND COAL GASIFICATION EXPERIMENT,
California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 2F.
W80-02674

PARTICULATE METALS IN WATERS OF A TYPICAL IRRIGATION RIVER: THE RIVER SAKURAGAWA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
H. Seki, M. Takahashi, K. Kobayashi, and S. Ishizaka.
Water, Air, and Soil Pollution, Vol 12, No 2, p 265-271, August 1979. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Rivers, *Lakes, *Water pollution, *Metals, On-site investigations, Chromium, Mercury, Lead, Cadmium, Iron, Manganese, Zinc, Pollutants, Foreign research, *Japan, *River Sakuragawa(Japan).

The particulate metallic elements in waters of a water system of the River Sakuragawa and Lake Kasumigaura were measured by the multielement analysis using particle-induced X-ray emission. The heavy metal particulates for environmental standards were less than 0.0001 ppm for Cd, 0.00037 ppm for Cr, and 0.00078 ppm both for Hg and Pb in the river waters. The predominant metal particles in the waters were Fe, Mn, and Zn. (Humphreys-ISWS)
W80-02683

DEPOSITION OF NUTRIENTS AND MAJOR IONS BY PRECIPITATION IN SOUTH-CENTRAL ONTARIO,
Ontario Ministry of the Environment, Rexdale (Ontario). Limnology and Toxicity Section.
For primary bibliographic entry see Field 2H.
W80-02685

THE EFFECT OF HEAVY METALS AND OTHER POLLUTANTS ON THE SEDIMENTS OF ONONDAGA LAKE,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W80-02686

POWER PLANT DIFFUSER-PIPE SYSTEM,
Auburn Univ., AL. Dept. of Civil Engineering.
A. D. Parr, and W. W. Sayre.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 105, No EE6, Proceedings Paper 15048, p 1075-1093, December 1979. 7 Fig, 4 Tab, 8 Ref, 2 Append.

Descriptors: *Difusion, *Thermal pollution, *River, *Model studies, *Mississippi River, Hydraulic models, Flumes, On-site investigations, Temperature, Water temperature, Mixing, Powerplants, Flow, Velocity, Surveys, Standards, Water quality, Water quality standards, Diffusers, Diffuser-pipe systems.

Results were presented for a comprehensive model and prototype experimental study of a submerged multiport diffuser discharging heated water from a steam-electric generating station into the Mississippi River. The principal objectives of the study related to prediciting thermal mixing zones. Temperature and velocity distrubutions were studied in the region just downstream from individual ports in both model and prototype and at a cross section about 1/4 of the local river width downstream from the diffuser in the prototype. The river below which the applicable thermal standards would be violated was predicted. Comparisons showed that the performance of the prototype multiport diffuser ports can be represented satisfactorily by a 'sectional' laboratory flume model. (Sims-ISWS)
W80-02692

ASSIMILATIVE CAPACITY OF SMALL STREAMS,
Parsons, Brinckerhoff, Quade, and Douglas, Inc., New York.
C. T. Bathala, K. C. Das, and W. D. Jones.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 105, No EE6, Proceedings Paper 15082, p 1049-1061, December 1979. 4 Fig, 2 Tab, 8 Ref, 2 Append.

Descriptors: *Streams, *Waste assimilative capacity, *Water quality, *Model studies, *Virginia, Dissolved oxygen, Biochemical oxygen demand, Mathematical models, Low flow, Sewage treatment, Effluents, Water pollution, Water pollution sources, Pollutants, Permits, Waste water, *Coleman Creek(VA), *Flat Creek(VA).

A rational basis for modeling small streams to determine assimilative capacity in order to assign waste-load allocations to meet the requrements of Public Law 92-500 is necessary. This paper summarized the results of waste-load assimilation analyses of Coleman Creek at Boydton and Flat Creek near South Hill, Virginia, and the possible impact on these communities. The assimilative capacity of each stream was analyzed by using modified Streeter-Phelps methodology, a water quality model for self-purification of small streams. Based on the results of these studies, it became apparent that very stringent effluent limits, overtaxing the financial capabilities of these communities, would be needed to maintain the existing stream DO standards. Accordingly, to prevent undue economic hardship to these communities, the concept of issuing a tiered permit was considered in order that a seasonally controlled system of waste treatment could be utilized, i.e., higher and more expensive treatment step may by required only during periods of low flow. These strategies will decrease the capital costs of the plants and will significantly lower the operating and maintenance cost. (Sims-ISWS)
W80-02693

SWMM APPLICATION TO COMBINED SEWERAGE IN NEW HAVEN,
Cardinal Engineering Associates, Meriden, CT.
For primary bibliographic entry see Field 2E.
W80-02694

5C. Effects Of Pollution

CHEMICAL AND BIOLOGICAL SURVEY OF THE UPPER GILA RIVER SYSTEM IN NEW MEXICO: PRELIMINARY STUDY OF NUTRIENTS IN SNOW AND QUEMADO LAKES,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
D. K. Brandvold, J. A. Brierley, and C. J. Popp.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127269, Price codes: A04 in paper copy, A01 in microfiche. New Mexico State Water Resources Research Institute, New Mexico State University, Las Cruces, Report No 110, November 1979. 48 p, 18 Fig, 13 Tab, 19 Ref. OWRT A-060-NMEX(1), 14-34-0001-7006.

Descriptors: *Baseline study, *Water quality, *Eutrophication, *Heavy metals, Bacteria, Algae, Nutrients, *Gila River System(N Mex), Nutrient levels.

Baseline water quality was investigated for a sector of the Gila River System near its headwaters in New Mexico. A part of this system is very heavily used for recreation. In addition, three fishing/rec-

reational lakes were studied to attempt to find the causative factors for destructive algal blooms. Levels of nutrients, heavy metals, bacteria, and algae were determined in addition to general water chemistry profiles. It was found that although algal blooms occur, especially in Snow Lake, the nutrient levels were not exceptionally high. Elevated nitrogen concentrations were probably due to fixation of nitrogen by microorganisms. A significant factor seemed to be the available phosphate in Snow Lake. This lake also warmed earlier than Quemado Lake which may have been important in providing a longer period for algae growth. A few heavy metal levels were higher than would have been expected. No correlation appeared between bacterial counts and water chemistry. (Herman-New Mexico)
W80-02405

IMPACT OF WESTERN COAL MINING - II. MICROBIOLOGICAL STUDIES,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W80-02416

OIL IN THE SEA,
A. D. McIntyre.
Scottish Fishery Bulletin, Vol 45, p 37-41, 1979.

Descriptors: *Oil pollution, *Commercial fishing, *Path of pollutants, Commercial fish, Commercial shellfish, Oil, Oil spills, Chemical properties, Toxicity, Mortality, Fish physiology, Animal metabolism, Oily water, Offshore platforms, Water pollution sources, *Crude oil.

Since the discovery of gas in the southern North Sea in the early 1960s and of oil at the Ekofisk field in 1969, there has been a progressive development of oil exploitation round Scottish coasts, extensive construction of onshore facilities and considerable expansion of oil transportation by ships and pipelines. There has also been a number of recent dramatic incidents in Western Europe - the Ekofisk Bravo blowout, the Amoco Cadiz grounding and the 'Eleni V' collision. It is thus natural that fishermen and anyone concerned with fish as food should ask for an assessment of the effects of oil in the sea. Many aspects of the effects of oil are discussed. First, an overview of the origin and composition of oil is given. The behavior of several types of crude oil when spilled is outlined. Next, the effects of oil on commercial organisms is addressed from two major aspects - the tainting of fish and shellfish and direct toxicity to these organisms. Finally, the effects on fishing of the physical presence of rigs, platforms or pipelines, and the damage which can be done to gear by debris on the sea bed are reviewed. (Deal-EIS)
W80-02418

IMPACT OF BIOLOGICAL AND CHEMICAL MOSQUITO CONTROL AGENTS ON NONTARGET BIOTA IN AQUATIC ECOSYSTEMS,
California Univ., Riverside.
M. S. Mulla, G. Majori, and A. A. Arata.
Residue Reviews, Vol 71, p 121-173, 1979. 1 Tab, 207 Ref.

Descriptors: *Mosquitos, *Pest control, *Toxicity, Pesticides, Insecticides, Insect control, Public health, Biocontrol, Predators, Pathogenic bacteria, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Carbamate pesticides, Larvicides, Mode of action, Pesticide toxicity, *Insect growth regulators.

In this review the ecological and environmental impact of biological and chemical control agents employed for the management and suppression of pest and vector mosquitoes in aquatic habitats is analyzed. Most, if not all, available published information has been scrutinized with regard to the most widely used control agents in aquatic ecosystems for mosquito control. Among the biological control agents, larvivorous and predaceous fish are the most commonly utilized agents for mosquito control at the present time. The general notion that all biocontrol agents are specific and have little or no effect on the nontarget biota are dispelled on the basis of available research data. From the evidence prevailing in the literature, some chemical control agents are quite innocuous while others pose a great potential hazard to nontarget biota. Efforts are and should be made to screen, evaluate, and develop more specific, less hazardous, and less toxic agents, formulations, techniques, and control strategies for the management of disease vectors and pestiferous arthropods. (Deal-EIS)
W80-02419

EFFECTS OF CHLORINATED ORGANICS FROM WASTEWATER TREATMENT ON ALGAL GROWTH,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W80-02420

TOXICITY OF LANDFILL LEACHATES TO UNDERYEARLING RAINBOW TROUT (SALMO GAIRDNERI),
Fisheries and Marine Service, West Vancouver (British Columbia).
J. R. McBride, E. M. Donaldson, and G. Derksen.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 806-813, 1979. 4 Tab, 19 Ref.

Descriptors: *Toxicity, *Rainbow trout, *Leachate, Solid wastes, Landfills, Growth stages, Bioassay, Fish physiology, Fish diseases, Animal pathology, Mode of action, Chemical properties, Salmonids, *Tissue analysis, *Blood chemistry.

The objective of this study was to document the sublethal response of a salmonid (Salmo gairdneri) to leachate from a Greater Vancouver Regional District landfill site. To evaluate acute toxicity static 96 h LC50 bioassays were carried out. Values in four tests ranged from 5.8% to 7.5%. Sublethal toxicity was studied in two ways: histopathology and plasma corticosteroid concentration. Both concentration of leachate and length of exposure were varied for these tests. Leachates did not visibly affect the structure of liver, kidney, gill, skin or alimentary tract. In contrast, the interrenal, i.e., adrenocortical tissue homologue, of those fish exposed to the maximum concentration of the pollutant exhibited profound changes. Plasma cortisal concentrations were significantly elevated at maximum leachate concentrations for all exposure times. With one exception, small concentrations had insignificant effects on plasma cortisal levels. These changes were clearly due to a stress response induced by the leachates. (Deal-EIS)
W80-02422

EFFECT OF MERCURY ON THE MORPHOLOGY OF ERYTHROCYTES IN ANABAS SCANDENS,
Berhampur Univ., Orissa (India). Lab. of Environmental Toxicology.
For primary bibliographic entry see Field 5B.
W80-02423

RESUSPENSION OF OIL: PROBABLE CAUSE OF BROWN PELICAN FATALITY,
Fish and Wildlife Service, Victoria, TX. Gulf Coast Field Station.
K. A. King, S. Macko, P. L. Parker, and E. Payne.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 800-805, 1979. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Water birds, *Mortality, *Oil spills, Oil, Oil pollution, Gas chromatography, Chemical analysis, Salt marshes, Oily water, Path of pollutants, Suspension, *Pelicans, *Pelecanus, Oil resuspension.

An adult brown pelican (Pelecanus occidentalis) was found oiled and died shortly thereafter. Gas chromatographic analysis linked the oil to a spill which had occurred six weeks earlier. The death of an individual of an endangered bird species 6 weeks after the original spill emphasizes that not all mortality associated with oil spills is immediate and obvious. Oil spilled in salt marshes persists for long periods; consequently special attention must be paid to these areas. Resuspension of oil trapped in pools or in sediments can result in the recontamination of adjacent waters. This is the first instance of which we are aware that resuspended oil may have resulted in bird mortality. (Deal-EIS)
W80-02425

COMPARATIVE EFFECTS OF SEDIMENT AND WATER CONTAMINATION ON BENTHIC INVERTEBRATES IN FOUR LAKES,
Alberta Environmental Center, Vegreville.
J. W. Moore, V. A. Beaubien, and D. J. Sutherland.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 840-847, 1979. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Heavy metals, *Toxicity, *Benthic fauna, *Mercury, *Copper, *Lead, *Zinc, Bottom sediments, Water chemistry, Bioindicators, Dominant organisms, Biological communities, Lakes, Arctic, Diptera, Mollusks, Amphipoda, *ARSENIC, *Species diversity, Canada.

Benthic invertebrate communities are often exposed to two sources of contamination, the substrate and the overlying water. This may create an interaction among pollutants and consequently, there have been few attempts to determine the impacts of both polluted water and sediments on benthic invertebrates. In this investigation the concentrations of heavy metals in the sediments and waters of four lakes situated in the Canadian subarctic were determined from May 1977 to May 1978 and were correlated with differences in the species composition, diversity and density of the benthic communities. The data were also used to assess the value of indicator species as measures of water pollution. (Deal-EIS)
W80-02428

THE POTENTIAL ENVIRONMENTAL IMPACT OF MARINE GRAVEL EXTRACTION IN THE NORTH SEA,
Rijksinstituut voor Visserijonderzoek, Ijmuiden (Netherlands).
S. J. deGroot.
Ocean Management, Vol 5, p 233-249, 1979. 4 Fig, 48 Ref.

Descriptors: *Dredging, *Fish populations, *Water pollution effects, Bottom sediments, Herrings, Gravels, Mining, Cost analysis, Eels, Commercial fishing, Excavation, Underwater, *Netherlands, *North Sea.

The rapid increase in the mining of marine gravels in the North Sea offers a serious threat to the marine environment and especially to the herring populations of the southern North Sea and Channel. The paper discusses the extraction methods for gravel and the usefulness of applying programmed dredging to minimize the effects on the seabed. The impact of gravel extraction on the sea-bed and on the herring and sand-eel fisheries is discussed. It is estimated that the resources of marine gravel in the southern North Sea will be depleted within 50 years whereas the fisheries will be practiced for many hundreds of years to come. Therefore a careful evaluation, on a European level, is needed of the relative short-term benefits for the marine gravel industry and the long-term interests of the fisheries. (Deal-EIS)
W80-02429

MARINE POLLUTION – FACTS AND FICTION, THE SITUATION IN BRITAIN,
H. A. Cole.
Ocean Management, Vol 5, p 263-278, 1979. 26 Ref.

Descriptors: *Water pollution effects, *Aquatic environment, *Productivity, Commercial fishing, Commercial fish, Commercial shellfish, Herrings, Water quality, Water chemistry, Dissolved oxygen, Turbidity, Suspended solids, Sewage effluents, Metals, Organic compounds, Chlorinated hydrocarbon pesticides, Persistence, Water quality

standards, Radioactive waste disposal, *Great Britain.

The widely-held impression that serious biological damage has been done to the marine environment and its resources by pollutants is not soundly based. There is no evidence that any offshore stock of fish or shellfish has suffered a reduction in annual recruitment to the exploitable stock as the result of pollution. Production generally has been well maintained and where reduction in yield is evident, e.g. in herring around the British coasts, this is a consequence of over-fishing. Stocks of fish and shellfish inhabiting shallow coastal waters and particularly estuaries are subject to many human pressures, of which reduced water quality due to pollutants is one. The most damaging effects of pollution are reduction in available oxygen, increased turbidity due to suspended material and discolouration, and deposition of organic material on the bottom. Sewage and other organic effluents (such as food-processing wastes) with a high biological oxygen demand are the prime causes of these conditions. Potentially harmful metals and synthetic organic substances resistant to breakdown may accumulate in estuarine and coastal sediments, particularly muddy sands, silts and muds containing a high proportion of organic matter, and will continue to release potential pollutants long after shore discharges are controlled. Attention to marine pollution problems needs to be focussed on such estuarine and coastal sediments and the ways by which their polluting loads are built up and released. A better understanding of the effects of sewage discharge to the marine environment of the United Kingdom is needed and might bring about a modification of the present policy of sewage disposal. (Deal-EIS)
W80-02430

MODIFICATIONS OF AN EXPERIMENTALLY POLLUTED ECOSYSTEM IN THE LAGOON OF STRUNJAN, NORTH ADRIATIC,
Marine Biological Station, Portoroz (Yugoslavia).
For primary bibliographic entry see Field 5B.
W80-02432

THE EFFECT OF POLLUTION FROM LARGE-SCALE AGRICULTURAL PRODUCTION ON THE LIVING ENVIRONMENT OF THE FISH IN THE TROUT ZONE, (IN BOHEMIAN),
Vyzkumny Ustav Rybarsky a Hydrobiologicky Vodnany (Czechoslovakia).
A. Kominek.
Buletin VURH Vodnany, Vol 3, p 13-16, 1979. 2 Tab, 8 Ref. (English summary).

Descriptors: *Trout, *Toxicity, *Agricultural wastes, Flow rates, Streams, Benthic fauna, Mortality, Salmonids, Water temperature, Water pollution sources, Habitats, Dissolved oxygen, Water pollution effects, Agricultural runoff, Agricultural watersheds, Saprobic index, Trout, Freshwater fish.

The continuing pollution of trout waters, caused by agricultural production, affects with increasing severity the streams which are poorer in water, whereas those with higher flow rates are affected to a lesser degree. The difference in the worsening of saprobity in the two trout brooks---Krasovka and Stariesky potok---was about 1 saprobity degree in favour of the higher-flow brook. The best information on the effect of agricultural pollution on smaller trout waters is provided by the evaluation of the macrobenthos from the view-point of saprobic classification. The values obtained in the Krasovka signify the danger of the mortality of salmonids at lower flow rates and at higherwater temperatures at the same time. (Deal-EIS)
W80-02443

RELATIONSHIPS OF ACTIVITIES OF METAL-LIGAND SPECIES TO AQUATIC TOXICITY,
Minnesota, Univ.-Duluth. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W80-02444

AN ASSESSMENT OF THE THERMAL EFFECTS ON STRIPED BASS LARVAE ENTRAINED IN THE HEATED DISCHARGE OF THE INDIAN POINT GENERATING FACILITIES UNITS 2 AND 3,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5A.
W80-02446

A RELATION BETWEEN LAKE MORPHOMETRY AND PRIMARY PRODUCTIVITY AND ITS USE IN INTERPRETING WHOLE-LAKE EUTROPHICATION EXPERIMENTS,
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
E. J. Fee.
Limnology and Oceanography, Vol 24, No 3, p 401-416, May 1979. 9 Fig, 1 Tab, 49 Ref.

Descriptors: *Ontario, Canada, *Experimental lakes area, *Primary productivity, *Lake morphometry, *Lakes, Eutrophication, Epilimnion, Mathematics, Mathematical studies, Nutrients, Phosphorus, Nitrogen, Algae, Phytoplankton, Sedimentation, Sediment-water interfaces, Depth, Volume, Cycling nutrients, Chlorophyll, Sediments, Correlation analysis.

Primary production rates expressed per epilimnion unit volume linearly relate to the ratio of epilimnion sediment area to epilimnion volume in unferilized lakes in the Experimental Lakes Area (ELA), northwestern Ontario. This ratio is mathematically equivalent to the probability of sedimenting particle retention in the epilimnion divided by the mean epilimnion depth and measures lake nutrient recycling rates. The problem of relating lake morphometry and thermal structure to primary production came into prominence during primary production data analysis of a 4-year period at ELA. In comparison to control lakes, the ratio of production to chlorophyll in experimental lakes is high when chlorophytes dominate and low when cyanophytes dominate. Lakes fertilized with both nitrogen and phosphorus have much higher chlorophyll concentrations and productivities than control lakes. Both nutrients are in short supply; however, phosphorus is still the key for controlling eutrophication. Epilimnion nutrient recycling in ELA lakes is dominated by processes occurring at the sediment-water interface. The relationship between the ratio of sediment area to epilimnion volume and primary production is used to interpret whole-lake eutrophication experiments. (Danovich-Wisconsin)
W80-02462

AN EXAMINATION OF THE EFFECTS OF NUTRIENTS ON THE WATER QUALITY OF SHALLOW RIVERS,
Ontario Ministry of the Environment, Toronto. Limnology and Toxicity Section.
S. L. Wong, B. Clark, and R. F. Kosciuw.
Hydrobiologia, Vol 63, No 3, p 231-239, 1979. 8 Fig, 4 Tab, 46 Ref.

Descriptors: *Nutrients, *Water quality, *Rivers, *Shallow water, *Dissolved oxygen, Lotic environment, Plant populations, Plant growth, Oxygen, Oxygen demand, Biological communities, Respiration, Plant physiology, Biomass, Standing crops, Productivity, Growth rates, Model studies, Algae.

Although nutrient removal prevents further water quality deterioration, both qualitative and quantitative manipulation of plant communities is necessary to maintain desirable oxygen levels. Unlike lake systems, river quality cannot be characterized by nutrient concentrations. Although BOD is frequently used to monitor waste loading, enriched river sections other than those exposed to immediate outfalls, will not necessarily exhibit BOD problems. Higher plant communities together with benthic and periphyton populations are responsible for nighttime oxygen depletion. Minimum respiration rate derived during hours of total darkness comparatively better describes the plant community than daily mean respiration values. When dissolved oxygen criteria are considered in eutrophication models, nutrient concentration may not represent the prime controlling factor. External nutrient conditions may also not relate to plant growth: a plant's capacity for high nutrient storage hinders determining nutrient sufficiency levels. Differences in nutrient uptake were observed in Claophora in lentic and lotic environments. Nutrient sufficiency levels are not shared by all plants communities, especially when complicated by the unknown effects of root systems. Dissolved oxygen content is governed to a great extent by plant biomass distribution, a neglected parameter in water quality. Therefore, quantitative biomass control measures must be incorporated into water quality management plans for shallow rivers. (Danovich-Wisconsin)
W80-02463

PHYSICO-CHEMICAL ENVIRONMENT, PHYTOPLANKTON BIOMASS AND PRODUCTION IN OLIGOTROPHIC, SOFTWATER LAKE KALGAARD, DENMARK,
Aarhus Univ. (Denmark). Botanical Inst.
M. Sondergaard, and K. Sand-Jensen.
Hydrobiologia, Vol 63, No 3, p 241-253, 1979. 10 Fig, 3 Tab, 42 Ref.

Descriptors: *Lake Kalgaard, Denmark, *Productivity, *Biomass, *Phytoplankton, *Physicochemical properties, Oligotrophy, Chlorophyll, Primary productivity, Water chemistry, Nitrates, Phosphates, Seasonal, Algae, Nitrogen, Limiting factors, Phosphorus, Chemical analysis, Chemical properties, Carbon dioxide, Ions, Secchi disks, Depth, Distribution.

Physico-chemical environment, phytoplankton biomass and production in Lake Kalgaard, Denmark, 1976-1977 is described. Kalgaard is a small seepage lake (10.5 ha) with 11 m maximum depth. A well defined hypolimnion is absent. Chemically the lake is characterized by low total C02 and inorganic nutrient (N,P) concentrations and by Na and Cl ionic dominance. The ionic composition resembles that of precipitation (Na>Ca>Mg>K and Cl>S04>HC03). Total C02 increased markedly during July from 250-600 kg C/lake, primarily due to bottom accumulations, and afterwards decreased from September to October. N03 concentrations were relatively high from late autumn through spring (80 micro g/l) and dropped to extremely low values (1 micro g/l) during summer. P04 shows that the opposite pattern and is detectable only during summer (12 micro g/l). Chlorophyll a concentrations were below 10 micro g/l in surface waters (0.4 m) apart from a single maximum in September (45 micro g/l). During summer stagnation, a pronounced chlorophyll a maximum (100 micro g/l), developed at 6 m. Algal growth at 6 m is possible since the euphotic zone extends into the metalimnion: Secchi disc transparency is 4-6 m. Nitrogen is the major factor limiting biomass during summer stratification whereas phosphorus is more important at other seasons. Annual production (55 g C/sq m yr for deepest part, 32 g C/sq m yr average lake) shows that Kalgaard is an oligotrophic, softwater lake. (Danovich-Wisconsin)
W80-02464

NOTE ON RAPID AND SENSITIVE METHOD FOR THE DETERMINATION OF ANIONIC DETERGENTS IN NATURAL WATERS, AT THE PPB LEVEL,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
M. S. Gagnon.
Water Research, Vol 13, No 1, p 53-56, 1979. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Analytical techniques, *Solvent extraction, *Measurement, *Detergents, *Anions, Spectrophotometry, Testing, Testing procedures, Copper, Water chemistry, Chemical analysis, Chemistry, Freshwater, Saline water, Waste water(Pollution), Methodology, Pollution identification.

A rapid and sensitive method for determining anionic detergents in natural waters is developed from the original work by Crisp using bis (ethylenediamine) copper (II) ion. Standard reference anionic detergent solution sodium doecyl sulfate (SDS) is used with ethylenediamine Cu (II) as a

reagent. The ratio of sample:reagent:chloroform is maintained at 20:1:1. Atomic absorption spectrophotometry is also used. The procedure is suitable for 0-50 micro g/l detergent (SDS) concentrations but its applicability extends up to 15 micro g/ml. Recovery is 80% at 1 micro g/l, reaches 90% at 10 micro g/l and is 97% at higher concentrations. Method detection limit, or the concentration which gives an absorbance value equal to twice the standard deviation, is 0.3 micro g/l. Interference by natural organic chelators can occur when detergent concentrations were at the ppb level. Continuously measuring the chloroform-extractable copper in the sample evaluates possible error and obtains better detergent concentration accuracy. (Danovich-Wisconsin)
W80-02465

QUANTITATIVE DESCRIPTION OF STEADY STATE, NUTRIENT-SATURATED ALGAL GROWTH, INCLUDING ADAPTATION,
Rochester Univ., NY. Dept. of Biology.
T. T. Bannister.
Limnology and Oceanography, Vol 24, No 1, p 76-96, 1979. 8 Fig, 7 Tab, 64 Ref.

Descriptors: *Equations, *Algae, *Growth rates, *Light, *Mathematical studies, *Irradiation, Phytoplankton, Photosynthesis, Respiration, Chlorophyll, Adaptation, Nutrients, Equilibrium, Cultures, Limiting factors, Publications, Surveys, Cytological studies, Light intensity, Chlorella, Laboratory tests, Mathematics.

Four simple equations together with values of eight constant parameters provide a complete, self-consistent, reasonably accurate description of nutrient-saturated algal growth. The theory proves that C:chlorophyll a ratio (theta), respiratory rate (R-p), and light saturation parameter (E-p) of the photosynthetic light curve, alone are adaptative, and that adaptation of these parameters underlies the differences between light curves of growth and photosynthesis. The new model of nutrient-saturated growth incorporates the results of Phillips and Meyers on Chlorellpyrenoidosa cultures at 26 C under continuous illumination. Derived equations agree with experimental ones. Phytoplankton growth is described by four equations: (1) an empirical equation relating growth rate and absorbed irradiance; (2) a different equation relating growth rate and absorbed irradiance derived from equation; (3) an empirical equation relating R-p to growth rate; and (4) an equation stating the approximate constancy of the ratio E-p:thta. The equations can be solved simultaneously. Since they not only described respiration and light curves of growth and photosynthesis but also predict E-p and theta, the equations constitute an improved model of nutrient saturated algal growth; given any irradiance the equations predict growth rate, R-p, E-p, theta, and the specific photosynthetic light curve. (Danovich-Wisconsin)
W80-02466

ENRICHMENT OF ZN, CD, PB, AND CU IN THE SURFACE MICROLAYER OF LAKES MICHIGAN, ONTARIO, AND MENDOTA,
Clemson Univ., SC. Dept of Environmental Systems Engineering.
A. W. Elzerman, and D. E. Armstrong.
Limnology and Oceanography, Vol 24, No 1, p 133-144, 1979. 1 Fig, 8 Tab, 28 Ref.

Descriptors: *Surface tension, *Heavy metals, *Lake Michigan, *Lake Ontario, *Accumulation, *Lake Mendota(WI), *Monomolecular films, Physicochemical properties, Surfaces, Trace elements, Physical properties, Chemical properties, Lakes, Microenvironment, Lead, Zinc, Cadmium, Copper, Capillary action, Surfactants, Water properties, Surface waters, Films, Surface microlayers.

Data from Lakes Michigan, Onratio, and Mendota, 1973-1975, show that Zn, Cd, Pb, and Cu surface enrichment is common. Film pressures in areas of capillary wave damping are typically 2-10 dyn/cm. Concentrations of Zn, Cd, Pb and Cu are highest in rivers and harbor samples; heavy slicks in Lakes Michigan and Ontario exhibit surface pressures exceeding 22 dyn/cm. Lake Michigan midlake samples show lowest concentrations and least variability. Screen-collected surface microlayers samples generally contain higher Zn, Cd, Cu and especially Pb concentrations than samples from 30-m depth at the same site. Surface enrichment frequency and extent, especially for Pb, is greater in the presence of surface-accumulated material (SAM) as evidenced by visible foam or particulate matter or a film pressure 1 dyn/cm. Film pressure positively correlates with surface enrichment. Fractionation ratio and surface excess data indicate 100 ppm Zn, Cd, Pb and Cu concentrations may occur in the surface-enriched layer depending upon the actual SAM location. Trace metal surface enrichment is significant despite the small surface microlayer volume compared with total lake volume. Interactions between materials in the surface microlayer, including organic matter, particulate matter and microorganisms could be influenced by high trace metal concentrations. Capillary wave damping was frequently observed in all lakes. (Danovich-Wisconsin)
W80-02467

DYNAMICS AND CONTROL OF THE ASIATIC CLAM IN THE NEW RIVER, VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
D. S. Cherry, J. H. Rodgers, Jr., R. L. Graney, and J. Cairns, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-129703, Price codes: A05 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University Bulletin 123, 1980. 72 p, 14 Fig, 16 Tab, 47 Ref. OWRT B-101-VA (1).

Descriptors: Toxicity, Bioconcentration, Bioassays, Powerplants, Heated water, Nuisance shellfish, *Corbicula, *Asiatic clam, Population density, New River(VA).

The Asiatic clam, Corbicula fluminea, has invaded the New River at the rate of 9 miles a year from the Kanawha River, which enters downstream from the Glen Lyn coal-powered generating plant in Virginia. During the period of investigation, October 1976-September 1978, clams were more numerous in the vicinity of the thermal discharge of the plant than they were in unheated waters, and their population fell sharply during the winter months, when the water temperature dropped to approximately 2C. The temperature (35C) of the heated discharge water in late summer did not adversely affect the clam. High mortality occurred at temperatures greater or equal to 36C in laboratory thermal tolerance studies. The clam proved to be highly resistant to the conventional biocidal practice of intermittent chlorination and to exposure to heavy metals in both static and artificial stream bioassays. Copper was more toxic than either zinc or a combination of zinc and copper. Potassium was not an effective biocidal agent at low concentrations (less than 100 mg/l). Measurements of 42 elements in water, sediment, clam shell, and visceral tissue revealed that Corbicula was an efficient accumulator of many elements. Concentrations in all tissue samples were greater than those measured in river water. Fifteen elements were more concentrated in tissue samples than in river sediment, but the converse was true for 25 elements. Elements released from discharges at the Glen Lyn plant did not limit the clam's development or ability to propagate. Although only minor incidents of Corbicula infestation have been observed in the cooling system of the power plant, such infestation could become a serious problem if winter water temperatures rise. No effective means of controlling the clam's population has been developed.
W80-02471

BIOASSAYS RELATED TO THE EFFECTS OF COAL STRIP MINING AND ENERGY CONVERSION ON THE AQUATIC MICROFLORA,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W80-02476

RANGE OF CHANGES IN FISHPOND ENVIRONMENT INFLUENCED BY INTENSIVE CARP FARMING,
Polish Academy of Sciences, Golysz. Fish Culture Station.
J. Szumiec.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2137-2141. 6 Fig, 4 Ref.

Descriptors: *Fish farming, *Water quality, *Carp, *Phytoplankton, *Oxygenation, *Dissolved oxygen, Eutrophication, Aquatic productivity, Fish, Freshwater fish, Fish populations, Density, Population, Oxygen, Fish management, Aquiculture, Oxygen requirements, Water quality control, Nitrogen, Nitrogen compounds.

In intensive carp farm ponds (4000 kg/ha) mean daily primary production reaches 4 g 02/sq m most of the year and 7 g 02/sq m maximum in July from phytoplankton assimilation; nitrate and nitrite values are low, proving that they are quickly assimilated by bacteria and phytoplankton. In surface waters on sunny days, phytoplankton assimilation reaches 25 g 02/sq m. Despite greater phytoplankton numbers in intensive ponds, ponds are usually less oxygenated than fertilized ones (900 kg/ha) due to high oxygen consumption and weak light conditions. Carp in intensive ponds require up to 40 kg 02/ha/d for respiration and food digestion. Nevertheless, organic substance accumulation, expressed by oxidability, does not reach values at which anoxia is expected. Transparency in euphotic layers decreases from 120 cm in spring to 40 cm in summer. Artificial aeration can improve oxygen balance but is justified only at 8000 kg/ha production levels. In intensive ponds, undissociated ammonia concentrations are below 0.1 mg/l although these values are present in fertilized ponds. Nitrogen in intensive ponds is present mainly in organic or ammonia nitrogen forms, usually as decay products. (Danovich-Wisconsin)
W80-02486

ENDOHELMINTHS OF SALMONIDA FROM THE ARTIFICIAL LAKE PIVA, MONTENEGRO, YUGOSLAVIA,
Biological Inst., Titograd (Yugoslavia).
D. Kazic.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978. p 2154-2158, 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Fish disease, *Lake Piva, Yugoslavia, *Piva River, Yugoslavia, *Salmonids, *Ecological distribution, *Fish parasites, *Trematodes, *Nematodes, Parasitism, Infection, Yugoslavia, Dominant organisms, Distribution, Hosts, Epizootiology, Fish populations, Pathology, Brown trout, Rainbow trout.

Pathogenicity produced by Crepidostomum species, trematodes, is restricted to Piva River (Yugoslavia) headwaters and trout occurring in Piva Lake have few parasites. Regions of the Piva River and its tributaries have been impound since 1975 to make an artificial lake 44 km long and 200m deep. Predominate parasites in the river include trematodes Crepidostomum farionis and C. metoecus; they occur in fish stomachs (6.32%) intestines (53.37%), and gall bladder (53.16%). Infection intensity reaches a maximum 1,2000 organisms. Smaller numbers of fish have other trematodes such as Nicolla testobliqua, Allocreadium isoporusm, and Sphaerostomum globiporum. In Piva River tributaries, the same parasite species occur; however, some differences are present in numbers of hosts infected by some indohelminth classes. Piva River fish are affected more by trematodes than those in tributaries, while fish in tributaries are more affected by nematodes. Infection rates intributaries are also lower, (up to 48 parasites). In Piva Lake, 70.81% of brown trouts caught are infected: trematodes occur in 60.28% nematodes in 23.93%. C farionis species is common however, infection intensity reaches only 13 parasites. Nicolla testiobliqua infection intensity reaches 83 parasites. The most common nematode is Sterliadochona tenuissima. (Danovich-Wisconsin)

W80-02490

UTILIZATION OF FILAMENTOUS ALGAE BY FISHES IN SKADAR LAKE, YUGOSLAVIA,
Wisconsin Univ., Madison. Lab. of Limnology.
J. F. Kitchell, R. A. Stein, and B. Knezevic.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2159-2165, 2 Fig, 2 Tab, 15 Ref SFG-2-6308.

Descriptors: *Skadar Lake, Yugoslavia, *Fish diets, *Algae, *Food chains, *Cyprinid fish, *Nutrients, Fish, Fish behavior, Fish populations, Nutrient requirements, Phytoplankton, Metabolism, Fish physiology, Digestion, Food, Food habits, Biological communities, Ecology, Ecosystems, Food abundance.

Filamentous algae, although of low nutritional value, represents an abundant, readily accessible food resource for cyprinid fish Pachychilon pictum, Leuciscus cephalus and Rutilus rubilio, studied in Skadar Lake, Yugoslavia June-July 1973. Skadar Lake, located in Montenegro, Yugoslavia is a large, shallow, polymictic, subtropical lake; surface area varies 370-530 sq km due to annual flooding. Even though fish differ substantially in initial gut content weight, they have very similar gut clearance rates. Time for 50% depletion is 3.4 h. Guts are empty of digestible food 8 h after feeding. L. cephalus assimilation efficiency reaches 80% based on particulate matter recovered by dissection and filtration. Because depletion rates are similar, intercept values represent relative importance of algae in each species' diets. In decreasing order, it is R. rubilio, L. cephalus, and P. pictum. Algae comprises 42% of L. cephalus diet, 69% for P. pictum, and 89% for R. rubilio during June through September. All fish have fat deposits suggesting no energy deficits during mid-summer when algae is the primary food resource. Ash and indigestible organic matter for fresh Spirogyra is 41.2% and 5.4%, respectively, making digestible organic matter 53.4%. During digestion, ash content declines to 25%, probably resulting from dissolution of CaC03. Fecal matter contains more ash and indigestible matter and less digestible organic matter than fresh Spriogyra. (Danovich-Wisconsin)
W80-02491

UNIQUE CHARACTERISTICS OF ICHTHYOFAUNA AND ICHTHYOPARASITES OF SKADAR LAKE,
Biological inst., Titograd (Yugoslavia).
B. Knezevic, D. Kazic, D. Nedic, M. Kavaric, and B. Ivanovic.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2166-2171, 3 Tab, 29 Ref.

Descriptors: *Skadar Lake, Yugoslavia, *Fish, *Fish parasites, *Systematics, Fish types, Fish populations, Adaptation, Invasion, Pathology, Parasitism, Biomass, Infection, Trematodes, Nematodes, Hosts, Epizootiology, Speciation, Dominant organisms, Cyprinid fish, Climates, Water temperature.

Skadar Lake, Yugoslavia, is characterized by fish species of 15 families; Cyprinidae dominate with 96% of thebiomass and Cyprinus and Alburnus are the most commercially significant fish. Salmoniae are considered temporary lake species. In the last few years, seven new fish species were recorded; the majority are Cyprinidae. Increases in Carassius auratus biomass is foreseen, causing a decrease in many native species. Parasitological investigations reveal fish species infected and total invasion intensity: Gubio gobio (99.09%), Leuciscus cephalus albus (74.41%), Pachychilon pictum (73.51%), Alosa fallax nilotica (67.72%), and Chondrostoma kneri (62.81%). Parasites include trematodes, nematodes, cestodes, nad to a lesser extent, Acanthocephala. Pachychilon pictum is an endemic Skadar Lake species: 10 trematodes, seven nematodes, three cestodes, and four Acantocephala species are found in it. Extensive fish infection is explained by warm water temperatures brought about by the mild climate influencing more intensive fish nutrition and aquisition of invertebrate intermediate hosts over long time periods. Skadar Lake has potential human and mammal pathogenic lavae in several fish species; in addition, several larval forms can be transmitted to wild water birds. (Danovich-Wisconsin)
W80-02492

SIZE-SELECTIVE PREDATION BY FISH ON THIN-SHELLED GASTROPODS (LYMNAEA): THE SIGNIFICANCE OF FLOATING VEGETATION (TRAPA) AS A PHYSICAL REFUGE,
Oklahoma Univ., Norman. Dept. of Zoology.
A. P. Covich, and B. Knezevic.
In: Proceedings, Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2172-2177, 3 Fig, 20 Ref SFG-2-6308.

Descriptors: *Fish food organisms, *Skadar Lake, Yugoslavia, *Carp, *Floating plants, *Ecological distribution, *Gastropods, *Predation, Fish, Fish diets, Aquatic plants, Speciation, Habitats, Mollusks, Snails, Nitches, Ecotypes, Distribution.

Preliminary gastropod distribution surveys in the littoral zone of Lake Skadar, Yugoslavia, October 1975-July 1976 reveal that spine development in submerged Trapa fruits offers protection to Lymnaea from fish predation. Skadar Lake surface area fluctuates 370-530 sq km as water level rises 2 m in winter and early spring; transparency varies 0.5-3.0 m with high turbidity in winter. Many individual carp select small, thin-shelled species (Valvata piscinalis) over thicker-shelled, common ridged-morphs (Pyrgula annulata) apparently because Valvata can be crushed more readily by carp's pharyngeal teeth. However, Lymnaea auricularia are the most abundant thin-shelled species and are larger than Valvata. Dominant plants in the littoral zone are floating (Trapa longicarpa) and submerged species (Ceratophyllum desersum, Myriophyllum verticillatum, and Potamogeton natans). Lymnaea auricularia densities on Trapa range from 10-36/sq m. Sediment samples below Trapa beds contain low Lymnaea numbers. Data show high predation rates on small L. auricularia regardless of Trapa presence. However, predation on large L. auricularia declines when Trapa is present as a refuge. Trapa prescence, therefore, has less significance as a refuge for small gastropods than it does for larger ones. Because carp are primarily bottom feeders, they may infrequently search for prey on floating vegetation; spines reinforce Trapa's spatial refuge effectiveness. (Danovich-Wisconsin)
W80-02493

ALGAL POPULATIONS IN A MOUNTAIN POND (SWISS NATIONAL PARK),
Hydrobiological and Limnological Station, Kilchberg (Switzerland).
F. Schanz.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2188-2193, 2 Fig, 3 Tab, 8 Ref.

Descriptors: *God dal Fuorn Pond, Switzerland, *Algae, *Succession, *Chemical properties, *Population, *Trace elements, Water chemistry, Biomass, Primary productivity, Standing crops, Water properties, Cyanophyta, Bacteria, Mosses, Nutrients, Aquatic life, Ponds, Mountains, Density, Plankton, Phytoplankton.

Algal samplings of God dal Fuorn pond, Swiss National Park, 1975-1977, reveal special bacterial and blue-green algal species (Beggiatoa alba, Lamprocystis roseo-persicina, Thiocystis violacea, Desulfovibrio desulfuricans) which are able to adapt to a high content of sulfate, iron, magnesium and calcium in the water. The pond, with 43.5 cu m volume and 2.5 m maximum depth, has low oxygen content and traces of hydrogen sulfide. Dissolved ion concentration have been fairly constant for 40 years; human and animal pollution effects are practically negligible. Algal distribution occurs in three separate habitats: open water, bottom, and near Chara- and moss vegetation. Open water (50 ml) contains only 10-50 individual diatoms. Chara contraria and Chara foetida make up the most important benthos algal species; filamentous algae Spirogyra, Mougeotia, and Zygnema are also quantitatively important. Most algal species grow near Chara- or moss-vegetation and green algal numbers are markedly higher in these areas; species include Microspora amoena, Oocystis naegelii, Eremosphaera viridis, Cosmarium botrytis, Spirogyra, Mougeotia, and Microcystis parasitica. Pond algal biomass is descended from Characeae and Conjugatophyceae. Species succession in July-September is not detectable: monthly changes in algal densities are not evident. Biomass production is low because inorganic phosphorus and nitrogen levels are not detectable. (Danovich-Wisconsin)
W80-02495

ROLE OF NANNOPLANKTON IN PRIMARY PRODUCTIVITY STUDIES IN TROPICAL PONDS,
North Eastern Hill Univ., Shillong (India). Dept. of Zoology.
R. G. Michael, and V. M. Anselm.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretishce und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2196-2201, 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Nannoplankton, *India, *Ponds, *Primary productivity, *Tropical regions, *Algae, *Productivity, *Size, *Cytological studies, *Freshwater, *Light, Phytoplankton, Surveys, Light-dark bottle method, Analytical techniques.

Nannoplankton composition and absolute productivity values differ widely in 21 ponds near Madurai area of India; however, their gross and net contributions are quite similar to those of total plankton, reemphasizing nannoplankton significance incontrolling primary productivity. This survey provides further evidence on the significant contribution of nannoplankton, probably due to light utilization efficiency enhanced by decreased organism size. Nannoplankton is represented by four major algal groups: Chlorophyceae, Cyanophyceae, Bacillariophyceae, and Euglenophyceae. The maximum number of Chlorophyceae is 250,000/1, Cyanophyceae 250,000/1, Bacillariophyceae 75,000/1 and Euglenophyceae 2,500/1. Under tropical conditions, major phytoplankton components fall within nannoplankton size ranges and productive potential is largely controlled by nannoplankton size algae. In almost 60% of the ponds, net production forms 50-97.9% of the gross production in both total and nannoplankton indicating high P:R ratios. In nine ponds, gross nannoplankton production constitutes a considerable portion (77%) of gross total plankton production. However, in 11 other ponds, nannoplankton gross production exceeds that of gross total plankton production (137%). (Danovich-Wisconsin)
W80-02496

DENITRIFICATION IN THE SEDIMENTS OF LAKE OKEECHOBEE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. J. Messer, and P. L. Brezonik.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2207-2216, 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Lake Okechobee, Florida, *Sediments, *Dentrification, *Nitrogen compounds, *Sediment-water interfaces, Nitrates, Nitrites, Biochemistry, Nitrogen, Phosphorus, water pollution sources, Nutrients, Bacteria, Chemical properties, Chemical analysis, Aquatic plants, Lakes, Vegetation.

Denitrification, as measured by mass balance calculations, acts as a significant nitrogen sink in Lake Okeechobee, Florida, a large freshwater lake with 1850 sq km surface area and 2.7 m mean depth. The Kissimnee River is the most important nitrogen (N) source. Other important N sources include backpumped irrigation water from the Everglades agricultural area and rainfall. Phpsphorus (P) loading is dominated by Taylor Creek, which drains a

heavily pastured watershed. The Kissimmee River, rainfall, and backpumping also contribute to P loading. Areal loading is 4.23 g N/sq m-yr and 0.367 g P/sq m-yr. Nitrate and dentrification profiles indicate that spatial nitrification and denitrification relationships are more comlex than those occurring in undisturbed sediments. Based on a weighted areas average for different sediment types, the N:P ratio is 7.0. Nitrate concentrations and the N:P ratio decrease in similar patterns from the top few centimeters of sediment down to 20 cm. Below 20 cm, N:P ratio is constant and nitrate levels are low. Nitrate diffuses upward into the water and downward into anoxic sediments from the nitrate maximum. As much as 1.78 billion g N is denitrified annually in the lake, accounting for 26% of annual input. This N loss indicates an average denitrification rate of 0.96 g N/sq m-yr. Denitrification is unlikely in aerobic water columns and rates result from sediment reactions. An important storage not considered in calculations are extensive macrophyte (Potamogeton) beds in southwest lake sections. (Danovich-Wisconsin)
W80-02498

DENITROGEN FIXATION AND DENITRIFICATION IN SOME DANISH LAKES,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
V. B. Jensen, and K. I. Dahl-Madsen.
In: Proceedings: Congress in Denmark 1977. Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2217-2221, 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Nitrogen fixation, *Denitrification, *Lakes, *Denmark, Nitrogen, Nitrogen cycle, Nutrients, Water pollution, Nutrient removal, Waste waters, Water quality, Effluents, Surveys, Phosphorus, Nutrient budgets, Nutrient loading, Cycling nutrients.

Surveys of denitrogen fixation (DF) and denitrification in Danish lakes reveal that estimated dentrification rates are the same magnitude as proposed nitrogen (N) loadings, therefore, N removal could be cancelled by changed denitrification. However, the most pronounced effects of N removal occur in severely N-limited lakes, which usually also have the lowest denitrification rates. Lack of quantitative knowledge of relations between dentrification rates and environmental conditions for Danish lakes limits predictions of proposed N removal effects by general statistical models. Accumulated frequency curves for denitrification rates show a median of 9 g/sq m/yr; the 95th percentile is 50 g/sq m/yr. Median of the rates relative to N inflow is 13%; 95th percentile is 49%. Denitrification rates depend on surface area, mean depth, hydraulic retention time, nitrogen inflow, and phosphorus inflow. Nitrogen inflow is the dominating factor but no clear relations between parameters are apparent. Dinitrogen fixation measurements in lake summer 1974 for two Danish lakes were 2.0 g N/sq m/yr (011erup) and 1.0 g N/sq m/yr (Hvidkilde). Comparing DF rates to other N balance parts shows that DF does not contribute to N flow on a yearly basis, however, in late summer when N flow is low, DF is expected to significantly contribute to the N balance. (Danovich-Wisconsin)
W80-02499

MICROBIAL HETEROTROPHIC PRODUCTION IN TWO LAKES OF DIFFERENT PRODUCTIVITY,
New York State Dept. of Education, Albany. State Science Service.
R. H. Monheimer.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2222-2226, 2 Fig, 8 Ref. NSF BMS75-03352, DEB76-10591.

Descriptors: *Lake George(NY), *Canadarago Lake(NY), *Primary productivity, *Photosynthesis, *Heterotrophy, *Absorption, *Carbon cycle, *Sulfates, Plankton, Algae, Phytoplankton, Microorganisms, Oligotrophy, Eutrophication, Productivity, Timing, Depth, Light, Sulfur bacteria, Tracers.

Deviations from an expected correlation between sulfate and carbon uptake occur twice as often in Lake George as in Canadarago Lake, New York; therefore, heterotrophic productivity, as it relates to primary productivity is more important in oligotrophic than eutrophic waters. Low deviation rates in more eutrophic Canadarago Lake are due to the dominant algal role in sulfate uptake which diminishes heterotrophic productivity importance. Both uptake rates were measured with basic radioisotopes tracer techniques. Generally, both lakes' depth profiles exhibit sulfate uptake rates that parallel inorganic carbon uptake rates. However, in Canadarago Lake, five deviation incidents occurred where sulfate uptake rates increased while primary productivity decreased and five incidents occurred where sulfate uptake rates decreased while primary productivity increased. Similarly, in Lake George, variation incidents were six and ten, respectively. Normalized average time profiles show greater deviations in parallelism between carbon and sulfate uptake rates. An increase in sulfate uptake when primary productivity decreases means that heterotrophy is increasing. Heterotrophic production accounts for 37% of total planktonic microbial production in Lake George, but only 15% in Canadarago Lake. (Danovich-Wisconsin)
W80-02500

RESPONSES OF PHOSPHORUS REMOBILIZING CYTOPHAGA SPECIES TO NUTRITIONAL AND THERMAL STRESS,
Maryland Univ., College Park. Dept. of Microbiology.
W. Reichardt.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2227-2232. 7 Fig, 10 Ref.

Descriptors: *Nutrients, *Thermal stress, *Lake Constance, West Germany, *Growth rates, *Cytophaga, *Limiting factors, *Enzymes, Bacteria, Phosphates, Sediments, Phosphorus, Metabolism, Biochemistry, Microorganisms, Population, Biomass, Temperature, Nutrient requirements, Anaerobic bacteria, Anaerobic conditions, Aerobic bacteria, Water chemistry.

Alkaline phosphatase (AP-ase) activities of Cytophaga populations in Lake Constance, West Germany, are useful in describing potential phosphate enzymatic remobilization in lake water and sediments. Sediment samples with 20 mM glucose/l as an additional carbon source over short-time incubations have no significant influences on phosphatase levels. However, in hypolimnetic water, substrate accelerated Cytophaga elimination sets in after additional sources of carbon (glucose), organic phosphorous (beta-glycero-phosphate) and inorganic phosphorous (Na4P207), with glucose and Na4P207 preferently at higher temperatures (20C), with beta-glycero-phosphate most significantly at lower temperatures (5C). These temperatures-dependent population shifts occur as a response to growth limiting substrates populations are lacking. Experiments with Na4P207 at 5C show exceptional growth promotion. In Lake Constance sediments. AP-ase producing bacteria and AP-ase positively correlate only in topmost (0-1) layers. AP-ase production stimulation under restricted oxidative phosphorylation conditions, as assumed for deep, anaerobic sediment layers holds true only for Cytophaga johnsonae, but not for Chromobacterium lividium. (Danovich-Wisconsin)
W80-02501

POLYSACCHARIDE DEGRADATION BY AQUATIC CYTOPHAGA POPULATIONS IN A EUTROPHIC LAKE AND IN MIXED CULTURES,
Gesellschaft fuer Biotechnologische Forschung, Stockheim (Germany, F.R.).
H. Gude.
In: Proceedings, Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte limnologie, Vol 20, Part 4, 1978, p 2233-2237. 3 Fig, 15 Ref.

Descriptors: *Lake Constance, West Germany, *Enzymes, *Degradation(Decomposition), *Organic compounds, *Cytophaga, Eutrophication, Bacteria, Lakes, Batch cultures, Decomposing organic matter, Temperature, Succession, Population, Growth rates, Biomass, Microorganisms, Biochemistry, Ecology, Sediments, Littoral, Pelagic zone.

Field data from Lake Constance, West Germany, April-October 1975, confirm the importance of Cytophaga-Flavobacterium as polysaccharide-degrading heterotrophic bacteria. In littoral areas, epilimnic plate count maxima show little coincidence with algal maxima or with total carbohydrate concentration peaks. Cytophaga-Flavobacterium is the main taxonomic pectolytic flora group (97%). In pelagic areas at the end of August, Cytophaga-Flavobacterium are the most important polysaccharide degrader, reaching 23% of the pectolytic, 20% xylanolytic, and 18% amylolytic bacteria. In mixed cultures with polysaccharide-containing natural substrates (autoclaved algae) Cytophaga develops in succession after cocci and motile rod populations at 20C. Amylase and xylanase are produced by all populations, whereas pectinase and cellulase are detected only in presence of Cytophaga. At 5C, Cytophaga populations dominate from the beginning of the culture and all tested polysaccharidases are produced. The combined effect of substrate quality and temperature strongly influences microbial floral composition. Natural polysaccharide-containing substrates favor Cytophaga-Flavobacterium enrichment and corresponding hydrolytic enzymes. The main activities of this group are restricted to polymeric organic degradation, while easier substances are taken up by bacteria competing more effectively because of higher substrate affinities. High Cytophaga counts also indicate high polysaccharide degradation activities. (Danovich-Wisconsin)
W80-02502

HETEROTROPHIC CO2-FIXATION IN THE OBLIGATE METHANE-OXIDIZING STRAIN M 102 AND POSSIBLE ECOLOGICAL SIGNIFICANCE,
Max-Planck-Inst. fuer Limnologie zu Holstein (Germany, F.R.).
M. Naguib.
In: Proceedings, Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2238-2244. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Methane bacteria, *Carbon cycle, *Metabolism, *Organic compounds, *Photosynthesis, Temperature, Heterotrophy, Bacteria, Decomposing organic matter, Carbon, Cultures, Enzymes, Ecology, Growth rates, Biochemistry, Cycling nutrients, Animal physiology, Laboratory tests.

A laboratory investigation shows that methylotroph growth and multipilication takes place under favorable stratified conditions, aerobically, and with specific C-1 substrate; in a thermally startified lake, this occurs at the metalimnion/hypolimnion interface. Even in the oxygen-free hypolimnion, a non-growth methylotroph medium, CO2-fixation occurs. During full circulation periods, organisms are vertically distributed in the water column. C-1 substrate experimental preference shows the sequences Ch30H, CH4/HCHO. Introducing CH4 (methane) and CH30H simultaneouly exhibits summation of separate CO2-fixation intensities. According to peak height and area, methanol is preferentially taken up first, followed by methane. Methanol preference is ecologically interesting insofar as methanol is not only the first methane oxidation product but also an anaerobic pectin degradation product normally present in sediments. Although Strain M 102 does not grow or multiply in absolute methane environments without oxygen. CO2-fixation takes place under aerobic and anaerobic conditions. Strain M 102 CO2-fixation does not occur without the oxidizable substrate methane. In general, C-1 substrate, especially methane and definitely methanol, are always present in eutrophic lakes in appreciable concentrations to allow continuous CO2-fixation by methylotrophs. Specific CO2-fixation is most intensive at the beginning of the logarithmic growth phase and declines rapidly after that. CO2-fixation intensities decrease at 4C to one-third values at 20C. (Danovich-Wisconsin)

W80-02503

METABOLIC ACTIVITY OF BACTERIA IN THE RIVER DANUBE IN A YEAR CYCLE,
Institute of Experimental Biology and Ecology, Bratislava (Czechoslovakia).
I. Daubner, and B. Trzilova.
In: Proceedings, Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2245-2248. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Bacteria, *Heterotrophy, *Danube River, Austria, *Oxygen requirements, *Rivers, *Water quality, Oxygen, Analytical techniques, Culture, On-site tests, Water temperature, Water pollution, Environmental effects, Metabolism, Growth rates, Population, Enzymes, Oxygenation, Self-purification, Microorganisms, Annual, Seasonal.

Different utilization values of various organic substrates by heterotrophic bacteria are caused by physical and chemical water properties and by microflora composition; on the other hand, results are also influenced by analytical techniques. Heterotrophic bacteria metabolic activity in an Austrians segment of the Danube River, April 1976-March 1977, was measured by the Donderski and Trzilova method, which allows determination from bacteria directly isolated from water without errors caused by culture multiplication. Total microbe numbers ranged 190,000-6 million/ml. Heterotrophic bacteria numbers ranged 6,400-23,000/ml with a peak in November due to effects of the beet sugar working season. Heterotrophic activity on all substrates is not affected by the beet sugar season (October-December) when the river is enormously enriched by organic matter. Heterotrophic bacteria numbers do not correlate with metabolic activity. All substrates are more intensively used in spring. Glucose and xylose utilization curves are similar to each other; serine and pyruvate sodium pyruvate, one important substance in bacteria metabolic pathways. Oxygen consumption ranges from 70 (January) to 500 micro l (June). Next-highest values are obtained by amino acid serine substrates, followed by glucose and xylose. Glucose and xylose negatively correlate with water temperature, while their relationship to organic matter and BOD is positive. Serine and sodium pyruvate utilization more closely correlate with water temperature. (Danovich-Wisconsin)
W80-02504

GLUCOSE CONCENTRATIONS AND HETEROTROPHIC ACTIVITY IN LAKE KINNERET,
Israel Oceanographic and Limnological Research Ltd., Tiberias.
B. Z. Cavari, G. Phelps, and O. Hadas.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2249-2254. 2 Tab, 21 Ref.

Descriptors: *Lake Kinneret, Israel, *Heterotrophy, *Bacteria, *Analytical techniques, *Nutrient kinetics, *Turnovers, Algae, Enzyme, Metabolism, Kinetics, Carbon, Nutrients, Cycling nutrients, Nutrient requirements, Population, Bioassay, Respiration, Turnovers, Depth, Phytoplankton.

Natural glucose concentration, determined biweekly at different depths in a central 42 m area of Lake Kinneret, Israel October 1976-June 1977 fluctuates only slightly around 36.3 micro g/l, although concentrations vary between 7-110 micro g/l. Using an enzymatic glucose assay technique developed by Cavari and Phelps, high heterotrophic activity (1 micro g/l/h) was observed in samples taken at 0,3, and 10 m in October-November and at all depths in May-June. During September-November high non-Pyrrhophyta biomass occurs (14.0-20.2 g/sq m) compared to December-January values (4.2-2.7 g/sq m). Uptake rates correlate with phytoplankton abundance explaining high glucose rates in the photic zone (October-November). During May-June, when massive Peridinium deaths occur, heterotrophic activity increases are observed at all depths due to dead Peridinium cells sinking into deeper waters and sediment layers. Glucose turnover times range 16-625 hrs. During October-December turnover time is shorter in upper layers than in lower layers; in January-February when the lake is completely mixed, it is almost the same in the entire water column. Turnover time is again shorter in upper layers in March; short times are probably due to bacterial activity accompanying non-Pyrrophyta algae. In May-June the situation is opposite with longer turnover times in upper layers due to the breakdown of dead Peridinium cells causing shorter times in lower layers. (Danovich-Wisconsin)
W80-02505

CHANGES IN PLANKTONIC MICROBIAL POPULATIONS - AN ANALYSIS BY SCANNING ELECTRON MICROSCOPE,
Max-Planck-Inst. fuer Limnologie zu Holstein (Germany, F.R.).
C. Krambeck.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2253-2259. 3 Fig, 6 Ref.

Descriptors: *Bacteria, *Algae, *Population, *Biomass, *Electron microscopy, *Plussee, West Germany, Nutrients, Analytical techniques, Microorganisms, Growth rates, Diurnal, Biorhythms, Distribution, Light, Environmental effects, Animal physiology.

Scanning electron microscope results of planktonic communities of microorganisms in waters of Plussee, West Germany April-July 1976, show that bacterial populations react quickly to alterations in substrate supply by algae, explaining daily synchronizations which correspond to light dependent, algal excretion rhythms. Bacterial populations depend on algal physiological conditions as well as species composition. Bacterial longer-dividing stages increase and shorter ones decrease from sunrise until 0940 hrs which reveals a slower division at 0940 hrs and faster division at sunrise. The percentage of dividing stages is 7% at sunrise and only 4-5% during other light periods; moreover, tendencies towards more big and long dividing stages occurs in afternoon and sunset samples. Width is also more typical than length for a given bacterium. Bacterial biomass exhibit two maxima; one on 1 May after collapse of Chrysochromulina parva bloom. The second occurs from 15 June-17 July, following a significant algal biomass increase due to an Aphanizomenon bloom. In both cases width spectra appear shorter than at low bacterial number periods. Variations in width spectra show selective and physiological bacterial population reactions to environmental changes such as substrate supply and temperature. Mean bacterial volume per cell is 0.04-0.13 cu microns. Bacterial volume/ml lake water reaches 1% algal biomass; therefore, bacteria are not considered a significant nutrient pool. (Danovich-Wisconsin)
W80-02506

BACTERIA, BACTERIAL ACTIVITIES, AND UPTAKE KINETICS IN SURFICIAL SEDIMENTS OF A SMALL EUTROPHICATED MOUNTAIN LAKE,
Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
C. Steinberg.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2260-2263. 4 Fig, 6 Ref.

Descriptors: *Bacteria, *Sediments, *Kinetics, *Spitzingsee, West Germany, Eutrophication, Alpine, Mountains, Lakes, Walchensee, West Germany, Biomass, Littoral, Population, Metabolism, Photosynthesis, Photosynthetic bacteria, Aerobic bacteria, Anaerobic bacteria, Biochemistry.

This paper discusses the structural analysis of sediment bacterial populations in Spitzingsee, a small eutrophicated mountain lake in West Germany. Samples were collected 23 September 1976. Specific sediment weight varied 1.12-1.17 g/ml fresh weight (fs). Sediment in the greatest influent delta contains more minerals; dry weight was 0.61 g/ml instead of 0.22-0.28 g/ml at other sites and ignition residue was 0.56 g/ml instead of normal values 0.19-0.24 g/ml. All other sites also contained sediments rich in sulfides and anaerobic. Highest surficial bacteria numbers were 4.05-4.87 billion/g fs whereas numbers in littoral sediments were 1.06-1.97 billion/g fs. Anaerobic glucose uptake (V-max) in profundal sediments was 100 micro g/kg h, whereas littoral sediments utilize 300 micro g/kg h. C02 fixation does not show a particular distribution pattern. Anaerobic and aerobic activities are similar, ranging 12-24 mg C/kg h. Bacteria at the greatest influent delta fix the largest C02 quantities both anaerobically (73 mg C/kg h) and aerobically (88 mg C/kg h); this is due to lake shallowness and inorganic and organic allochthonous inputs. Thus, sediment bacteria adapt to relatively high nutrient concentrations. BOD values range 1.6-11.7 g 02/l 5d; mean DHA value is 2.8 mg H/10g 24h. Bacterial data is also compared to earlier investigations at Walchensee, a mesoproductive mountain lake. (Danovich-Wisconsin)
W80-02507

SPATIAL AND TEMPORAL DISTRIBUTION IN A MEROMICTIC KARSTIC LAKE BASIN: RELATIONSHIPS WITH PHYSIOCHEMICAL PARAMETERS AND ZOOPLANKTON,
Universidad Autonoma de Barcelona (Spain). Dept. of Microbiology.
R. Guerrero, C. Abella, and M. R. Miracle.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2264-2271. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Bacteria, *Lake Banyoles, Spain, *Distribution, *Meromixis, *Physicochemical properties, *Turnovers, Rotifers, Zooplankton, Ecological distribution, Distribution patterns, Microorganisms, Population, Biomass, Anaerobic bacteria, Sulfur bacteria, Spatial distribution, Ecology, Sediments, Chemical properties, Turnovers, Water circulation, Environmental gradient, Stratification.

Bacterial biomass in a meromictic basin of Banyoles Lake, northeast Spain, varies 0.02 mg/l at 1 m, 0.10 mg/l (15 m), 0.87 mg/l (22m m), to 975 mg/l (25m) in studies conducted December 1976-July 1977. Banyoles (106 ha surface area) undergoes complete spring and fall overturns; however, one lateral 7.5 ha basin (basin III), separated from the main water by 5 m shallows and wind-protected, exhibits permanent meromixis. Basin III is stratifed into three zones: A marked chemocline occurs at 18 m. Mixing occurs above this; below 18 m, water has a much higher conductivity and sulfide concentration, and is completely anoxic. A third zone is a soft, watery mud, or soft sediment, below 25 m which reaches 100 m deep in the central basin area. Bacterial vertical distribution shows important differences between the three zones. Bacterial biomass in mixolimnion layers fluctuates according to temperature, mixing, and primary production. Biomass in winter is relatively low (0.1 mg/l) and increases in early spring (3 mg/l). Monimolimnion layers are affected by upper layer productivity; values range 0.5-10 mg/l. In upper soft sediment layers, bacterial biomass is always extremely high (1-4 g/l), due to organic matter enrichment. Mud layer physicochemical and biological conditions are the most stable year round. Zooplankton vertical distribution and bacterial total numbers are inversely related near the chemocline, due to rotifer (Dilinus, Anuaeropsis) and copepod nauplii feeding on bacteria. (Danovich-Wisconsin)
W80-02508

SUSPENDED AND ATTACHED MICROORGANISMS IN A POLLUTED RIVER,
Ceskoslovenska Akademie Ved, Prague. Botanicky Ustav.
V. Straskrabova, P. Puncochar, B. Bojanovski, and J. Fuksa.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2278-2283. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Bacteria, *Biomass, *Water pollution, *Aquatic microorganisms, *Blankton, *Slime, *Sazava River, Czechoslovakia, Growth rates, Habitats, Water pollution sources, Coliforms, Microorganisms, Sewage effluents, Sewage disposal, Sewage bacteria, Environmental effects, Drifting(Aquatic), Suspended load, Sessile algae, Scum.

Both total biomass and ratio between bacteria groups are more strongly related to distance from pollution input for attached forms than for suspended microorganisms in the Sazava River Czechoslovakia, in a March-November 1975 study. Attached (slime) and suspended (free water) biomass of microorganisms were studied in Sazava, a 220 km river with 4,350 sq km drainage area, 23 cu m/sec mean discharge, and 20-30 cm/sec flow velocity. Two sampling points were regularly observed: one below an untreated municipal sewage discharge from Tynec (3000 inhabitants) and the other 10 km lower with no further greater pollution input. A total of 210 coliform bacteria strains were identified from the water and slime; half were Enterobacteriaceae. Quantitative differences between polluted and less-polluted sampling stations are more pronounced in slime than free water. Enteric bacteria slime growth in total standing crop is higher at the more-polluted station. Qualitative coliform bacteria composition differences are not noted between sampling stations or between water and attached slime. Percentage of suspended component in the total standing crop (per unit water surface) is 5-15% on more polluted and 10-80% on less polluted sampling stations. Specific glucose uptake activity of attached bacteria mixed in water is higher than that of planktonic bacteria. (Danovich-Wisconsin)
W80-02510

STRATIFICATION IN NATURAL POPULATIONS OF BLOOMFORMING BLUE-GREEN ALGAE,
Freshwater Biological Association, Ambleside, (England).
C. S. Reynolds.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2285-2292. 5 Fig, 34 Ref.

Descriptors: *Cyanophyta, *Algae, *Biomass, *Distribution, *Water temperature, *Stratification, *Lakes, Eutrophication, Growth rates, United Kingdom, Anabaena, Spatial distribution, Ecological distribution, Light, Light intensity, Depth, Euphotic zone, Epilimnion, Thermal stratification, Water circulation, Population.

Phytoplankton studies in three British lakes reveal that bloom-forming blue-green algal stratification is a predictable consequence of efficient buoyancy control, whenever the combination of thermally stable water layers and relatively high light penetration permits it; the phenomenon is rare since lakes in which this combination occurs are usually not dominated by bloom-forming species. Algal stratification is reported from eutrophic calcareous lakes Crose Mere (15.2 ha area, 9.3 m maximum depth) and Rostherne Mere, (48.7 ha area, 30 m maximum depth), and from an experimental Lund Tube (1630 sq m area, 11.9 m maximum depth) in Blelham Tarn, a soft-watered lake. May 1975, a 4.5 m depth Anabaena circinalis maximum was observed in Crose Mere. On 20 May, vertical heterogeneity was apparent with a significant maximum (12,000 cells/ml) at 3-6.5 m depth. By 28 May, the maximum increased to 20,000 cells/ml and moved above 5 m. Algal stratification disappeared by 4 June, with most algae distributed throughout the enlarged epilimnion. Microcystis aeruginosa depth maximum occurred in Rostherne Mere; an Aphanizomenon flos-aquae vertical bloom occurred in Blelham. Development depends upon stable thermal stratification and, to some extent, a thermal microstratification in the epilimnion. Algal stratification is temporary, never exceeding one month's duration; increased turbulence in algal depth maxima layers is largely responsible for its disruption. (Danovich-Wisconsin)
W80-02511

NITROGEN LIMITATION OF GROWTH AND GAS VACULATION IN OSCILLATORIA RUBESCENS,
New York State Univ., Purchase. Div. of Natural Sciences.
A. R. Klemer.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2293-2297. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Cyanophyta, *Limiting factors, *Growth rates, *Cytological studies, *Plant morphology, Cultures, Nitrogen, Plant physiology, Metabolism, Light, Light intensity, Algae, Nutrient requirements, Osmotic pressure, Turgidity, Turbidity, Nutrients.

Nutrient limitation experiments on Oscillatoria rubescens reveal no evidence that gas vacuolation increases with N-limited growth. In N-limited continuous cultures, relative gas vacuolation decreases as N becomes less available after a step-down in dilution rate; even in darkness, gas vaculation does not increase without NH4 enrichment. In continous-culture experiments, algal nutritional status is affected by step-function changes in dilution rate; a step-down from 0.29-0.18/day occurs on day 2 and a step-up back to 0.29/day on day 12 occurs. Shifts to lower dilution rates are followed by parallel declines in relative gas vacuolation and N sufficiency and by peaks in filament concentration. Macroscopic changes in algal buoyancy and pigment also take place. Step-up produces almost exact opposite results with peaks in relative gas vacuolation and N sufficiency and filament concentration decreases. Thus, gas vacuolation varies directly with algal N nutritional status and inversely with filament concentration. However, evidence that N limits growth and gas vacuolation simultaneously does not prove the latter is unaffected by growth rate. After the step-up in dilution rate, gas vacuolation increases before cell division increases; this is due to enhanced N assimilation by N N-starved cells and/or to a reduction in turgor pressure associated with an increased supply of limiting nutrient. (Danovich-Wisconsin)
W80-02512

DAILY RHYTHM OF REGULATION OF POLYPHOSPHATE METABOLISM IN AN ALGAL BLOOM OF OSCILLATORIA REDEKEI,
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.).
U. Zaiss.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, p 2298-2301, 1978. 2 Fig, 6 Ref.

Descriptors: *Cyanophyta, *Plussee, West Germany, *Diurnal, *Metabolism, *Phosphorus compounds, Eutrophication, Phosphorus, Phosphates, Plankton, Cytological studies, Plant physiology, Proteins, Enzymes, Photosynthesis, Carbon dioxide, Orthophosphate, Nutrients, Nutrient requirements, Fluctuations, Nocturnal, Time.

Oscillatoria redekei bloom metabolism in Plussee, West Germany, measured 19-20 June 1975, exhibits high activities of polyphosphate kinase (PPK) and ratio of single polyphosphate fractions (A,B,C,D), indicating that phosphate is growth limiting. Plankton in epilimnion layers consisted of 70.8% Cyanophyceae; O. rededei made up 38.7%. Zooplankton were fairly numerous, especially at night (26.7%). O. redekei population was in the dying phase since it comprised 75% of the Cyanophyceae 48 hrs previous to the study. This is confirmed by continual increases in dissolved protein (4-7 micro g/ml). Particulate phosphate concentration is minimum at midnight, coinciding with maximum orthophosphate concentration. Orthophosphate comprises an extremely small fraction of epilimnion phosphate content; mean concentration is 2.2 micro g/l. Dissolved organic phosphate increases continually. Average PPK-specific activity is 300 U/mg protein. Fluctuations of individual polyphosphate fractions resemble those of the whole fraction. Mean ratio (A+B):(C+D) is 23:77. Polyphosphate pool fluctuations are exactly opposite those of metabolic activity, which are indicated by phosphorylated photosynthetic product levels. When photosynthetic activity is high, phosphate is supplied from internal stores and during the night, it is contributed to phosphate depots. CO2 deficiency at noon causes temporary polyphosphate formation. (Danovich-Wisconsin)
W80-02513

ON NITRATE UPTAKE BY OSCILLATORIA AGARDHII,
Amsterdam Univ. (Netherlands). Lab. for Microbiology.
W. Zevenboom, and L. R. Mur.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2302-2307. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Nitrates, *Nutrient kinetics, *Limiting factors, *Light, *Scillatoria agardhii, *Phosphates, Cyanophyta, Algae, Kinetics, Cycling nutrients, Nutrient requirements, Cultures, Michaelis-Menten equations, Cytological studies, Laboratory tests, Lake Wolderwijd, Netherlands, Plant physiology, Population, Growth rates, Light intensity.

Studies of the influence of nitrate (N)-, phosphate (P)-, and light-limitation on nitrate uptake by the blue-green alga Oscillatoria agardhii, grown in chemostat, show that half-saturation constant (K-s) and maximum nitrate uptake capacity (V-max) values act as physiological indicators for N-, P- or light-limited phytoplankton growth. However, additional information about physiological data, such as pigmentation and P-uptake kinetics are neede. V-max for N- and P-limited cultures were almost identical and relatively high (0.82 micro mol/mg h for N-limitation, 0.76 micro mol/mg h for P-limitation) compared with V- max values for light-limited culture (0.10 micro mol/mg h). At low growth rates, V-max for N-limited cells exceeded the specific uptake rate; however, at higher growth rates the discrepancy decreased. P-limitation simultaneously restricts nitrate uptake. N-limited and light-limited chemostat cultures at low growth rates, express low K-s values, while K-s is high in P-limited chemostat cultures. The physiological state of natural populations in Lake Wolderwijd, The Netherlands, during summer was determined by comparing lake data with laboratory cultures. Although lake nitrate concentrations were low, light-limitation rather than N-limitation probably prevailed, due to low V-max sample values. (Danovich-Wisconsin)
W80-02514

GROWTH OF SCENEDESMUS PROTUBERANS FRITSCH IN PHOSPHORUS-LIMITED CULTURES,
Institute of Limnology, Nieuwersluis (Netherlands).
H. J. Gons, D. Barug, H. Goossens, and J. G. Loogman.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2308-2313. 4 Fig, 17 Ref.

Descriptors: *Chlorophyta, *Phosphorus, *Limiting factors, *Growth rates, *Cytological studies, *Nutrient kinetics, Algae, Succession, Cultures, Laboratory tests, Cycling nutrients, Nutrients, Kinetics, Michaelis-Menten equations, Curves, Chlorophyll, Phosphates, Biomass, Light, Light intensity, Eutrophication.

Phosphorus-limited growth experiments on the green alga Scenedesmus show that biomass yield on phosphate changes markedly with growth rate. These changes correlate with growth-rate dependent intracellular concentrations of phosphorus compounds which are extractable with cold TCA and with only hot TCA; remaining fractions are much less affected. Extracellular phosphorus concentration with steady state growth at half the maximum rate is 6 micro g/l. Scenedesmus protruberans fritsch was grown on a mineral medium with an inorganic phosphate growth-limiting concentration, at 20 C and with continuous light, in chemostats. Particle number and total particle

volume decline with increasing growth rate; these result from changing intracellular phosphorus concentration. Growth rate and extracellular phosphorus in any fraction nor total phosphorus intracellular content are hyperbolically related to growth rate; these relationships are linear. Secendesmus chlorophyll content varies with growth rate; values are much lower than with light-limited cultures. Carenoids do not shift relative to chlorophylls. Algal succession in freshwater from diatoms to green algae to blue-green algae is explained by the following hypothesis; excessive phosphate loading acts indirectly in benefitting blue-green algae by causing changes in light distribution in water; this gives Oscillatoria a growth advantage over Scenedesmus. (Danovich-Wisconsin)
W80-02515

A MODEL OF THE SUCCESSION FROM GREEN TO BLUE-GREEN ALGAE BASED ON LIGHT LIMITATION,
Amsterdam Univ. (Netherlands) Lab. for Microbiology.
L. R. Mur, and R. O. Beijdorf.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2314-2321. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Computer models, *Succession, *Algae, *Simulation analysis, *Light intensity, *Cyanophyta, *Chlorophyta, Mathematical models, Model studies, Eutrophication, Growth rates, Biomass, Population, Computers, Dynamic programming, Light, Limiting factors, Phosphates, Water properties.

A model simulating light-and phosphate-dependent growth of green and blue-green algae confirms that energy supply together with algal energy-use efficiency are the important factors of succession from green to blue-green algae. Results confirm that Oscillatoria agardhii blooms are regulated by factors which define light conditions, mainly incident light intensity, suspended detritus, algal biomass, and water depth. The Monod equation is taken as a basis for growth. Model starting conditions include: 160 cm depth, 1 mg P.l phosphage concentration, 1 mg/l green algal concentration, 1 mg/l blue-green algal concentration, and 0.02/cm extinction of suspended materials and water. The 160 m water column is differentiated into six 10 cm layers. Layer 0 light intensity is initially too high to allow maximal green algal growth rate. After 12 days, average light intensity decreases so that green algae reach maximal growth rates in this layer. Shading diminishes growth in layers 3-6. Light distribution changes influence blue-green algae differently: average light intensity in layer 0 is always too high to permit blue-green algal growth and light conditions in deeper layers (3-6) are initially favorable. After 10-17 days, positive growth is maintained in layers 1-3. By blue-green algal growth in these layers and low energy consumption of blue-green algae in the dark, average biomass increases, ultimately resulting in a succession from green to blue-green algae. During the whole time, phosphate is available in all water layers. (Danovich-Wisconsin)
W80-02516

AN IMPROVED METHOD FOR MEASURING IRRADIANCE IN ALGAL CULTURES,
Amsterdam Univ. (Netherlands). Lab. for Microbiology.
J. G. Loogman, and L. van Liere.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2322-2328. 10 Fig, 6 Ref.

Descriptors: *Algae, *Cultures, *Light intensity, *Laboratory equipment, *Light penetration, *Analytical techniques, Light equipment, Measurement, Calibrations, Testing, Microenvironment, Cyanophyta, Chlorophyta, Population, Density, Suspension, Microbiology.

Photodiodes can be used to measure irradiance in algal cultures; they are sufficiently small to be placed in culture vessels, are cosine-corrected, have an opening angle 2 times 90 degrees, and can determine light distributions within culture vessels. When filters are not used, significant deviations from the ideal cosine-correction occur; however, with filter use an ideal cosin-correction is achieved. Photodiodes are linear up to 160 W/sq m. Average incident irradiance is linearly proportional to the adjusted lamp intensity, expressed by reference current, as measured with the selenium cell. Light distributions were determined in culture vessels containing Oscillatoria agardhii suspensions of various optical densities at 720 nm, in a vessel containing clear water and in vessels containing Scenedesmus protuberans suspensions. In the clear water vessel, despite increasing distance from the wall and thus from the lamp, no light attenuation takes place. In suspensions up to 0.2 O.D., organisms are subject to identical light conditions in all vessel sections. Light scattering by filamentous organisms differs from that by spherical organisms. Even at 2 O.D., not all incident irradiance is absorbed; the difference must be taken into account when calculating growth efficiencies in dense cultures. (Danovich-Wisconsin)
W80-02517

GROWTH AND NUTRIENT UPTAKE IN OUTDOOR MASS CULTURES OF SCENEDESMUS ACUTUS,
Ghent Rijksuniversiteit (Belgium). Facultiet Landouwwetenschappen.
H. R. Paelinck, and J. DeMaeseneer.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2329-2334, 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Cultures, *Nutrients, *Kinetics, *Growth rates, *Scenedesmus, *On-site investigations, Biomass, Chlorophyta, Nutrient requirements, Primary productivity, Nitrogen, Phosphorus, Light, Light intensity, Carbon, Diurnal, Nocturnal, Limiting factors, Mathematical models.

Experiments on the green alga Scenedesmus acutus grown in raceways during summer 1976 show that Paelinck and DeMaeseneer's mathematical model describing nutrient uptake can be used under field conditions with some restrictions. When cultures were renewed in the morning a -5% correction is compulsory for N and -10% for P. However, when cultures were renewed in the evening and additional correction of -5% for N and -10% for P was necessary. Outdoor experiments took place in raceways with 1.68 sq m surface area and 250 l culture volume. In reference cultures nutrients were given in excess whereas in remaining raceways N and P amounts were progressively reduced. DW production averaged 15.52 g/sq m in reference cultures (range 4.35-23.03 g/sq m). Average daily total solar insolation was 520 cal/sq cm d (89-686 cal/sq cm d). Light utilization efficiency varies 0.88-2.86% with 1.82% average. N-uptake experienced deviations of +1.83% to -10.5%; P-uptake differed from +7.15% to -15.81%. In the course of the day, progressively less N and P were taken up. In nutrient deficient cultures the same influences operate; however, maximum N-uptake deviation (-10.02%) occurred in morning. Deviations were the same magnitude in cultures with different retention times. Average light utilization efficiency diminished at higher retention times. (Danovich-Wisconsin)
W80-02518

INFLUENCES EXERTED BY SALINITY ON A NORFOLK BROADS STRAIN OF PRYMNESIUM PARVUM (CARTER),
University of East Anglia, Norwich (England). School of Environmental Science.
P. Holdway.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2336-2340, 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Algae, *Israel, *Norfolk, United Kingdom, *Growth rates, *Salt tolerance, *Salinity, Environmental effects, Calcium, Phosphates, Saline water, Brackish water, Hardness(water), Chemical properties, Salts, Metabolism, Halophytes, Population, Cultures, Laboratory tests, Cytological studies.

Salinity experiments on alga Prymnesium parvum obtained from Israel and from one of the Thurne Broads (shallow lakes linked by rivers in Norfolk England) show that both strains act similarly to low salinities, in terms of population growth and cell size. Dissimilarities are noted in pigment content and ichthyotoxic activity; cells from the English lakes tend to exert greater ichthyotoxicity than Israeli algae. Toxin produced by P. parvum, an euryhaline chrysomonad, has caused extensive fish kills in European and Israeli brackish waters. Both populations increase initially in salinities 22.46 and 11.23 parts per thousand (ppt). Populations grow after an initial decline at 8.42 and 5.62 ppt, whereas cells die at 2.81 and 1.12 ppt salinity. Cells grown in SM media show decreased growth rates at high (54 mg/l) calcium levels. Phosphate additions do not affect subsequent population growth. Salinity does not influence chlorophyll-a content per cell. However, chlorophyll-a; carotenoid ratios are 1.7-2.7 (English), compared with 1.2-1.4 for Israeli strains under all salinities. Broad cells possess greater ichthyotoxic activity; when grown in 5.62 ppt salinity media, in similar population densities as Israeli algae, they produce 75 ITU, thus exceeding the maximal Israeli cell toxin output. (Danovich-Wisconsin)
W80-02519

FACTOR ANALYSIS OF TEMPORAL AND SPATIAL PATTERNS OF MULTICELLULAR GREEN FRESHWATER ALGAE,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
H. Hillebrand.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, p 2341-2346,3 Fig, 9 Ref.

Descriptors: *Systematics, *Algae, *Distribution, *Ecotypes, *Botshol, The Netherlands, *Correlation analysis, *Factor analysis, Distribution patterns, Ecological distribution, Chlorophyta, Seasonal, Spatial distribution, Mathematical studies, Analytical techniques, Floating plants, Plant groups, Aquatic algae.

Factor analysis helps to describe periodicity and distribution of multicellular green algae in the Netherlands eutrophic lake area, Botshol; objective methods prove the existence of species groups, characteristic for particular periods of the year. Botshol is a marshland intersected by numerous ditches and ponds; Grote Wije, a small lake, is located on the SW part. Using factor analysis and correlation analysis, temperal and spatial species groups are established; comparison reveals 12 ecological species groups, delineated temporally and spatially. The basic scheme includes: (1) Epiphytic growths, dominated by Cladophera glomerata; (2) Growths, mainly epiphytes, in reed zones along various water bodies; (3) Floating algal masses in small ponds with Stratiotes aloides vegetation; (4) Floating algae in small isolated pools and in a small pond; and (5) Rhizoclonium growths. At a given sampling station, up to three groups can be found during one year. The summer group is of greater relative importance than other seasonal groups. Marked differences do not characterize perennial and annual species groups: most species are found occasionally in their period of expected absence. (Danovich-Wisconsin)
W80-02520

EXPERIMENTAL EFFECTS OF ISOETES LACUSTRIS L. ON THE DISTRIBUTION OF EH, PH, FE AND MN IN LAKE SEDIMENT,
Ulm Univ., (Germany, F.R.).
U. Tessenow, and Y. Baynes.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2358-2362, 4 Fig, 6 Ref.

Descriptors: *Lake sediments, *Soil chemical properties, *Rooted aquatic plants, *Soil-water-

plant relationships, *Metals, *Accumulation, *Feldsee, West Germany, Sediments, Sediment-water interfaces, Iron, Manganese, Hydrogen ion concentration, Submerged plants, Oxidation-reduction potential, Root zone, Soil chemistry, Oxygen, Distribution, Laboratory tests, Interstitial water.

Long-term laboratory experiments with Isoetes lacustris and sublittoral lake sediment from Feldsee, West Germany, show that oxygen release from Isoetes roots in the sediment causes iron (Fe) and manganese (Mn) oxides accumulation. In control columns, pH (7.0) and EH (50-150 mv) are relatively constant except for the topmost layer. In sediments influenced by Isoetes, pH is markedly less (4.8) and EH is correspondingly greater (500 mV) down to 15 cm depth. Steep gradients are found directly below living Isoetes roots 15-18 cm down. In lower layers (20-25 cm) pH and EH of both control and Isoetes sediments are equal. In controls, Fe and Mn gradients start in uppermost layers, whereas the Isoetes present, concentrations drastically decrease down to 15 cm. Gradients start below this level and rise steeply. Final Fe and Mn concentrations below 20 cm are identical with controls. In experiments, with Isoetes, owing to oxygen released from plant roots, the oxidized upper sediment layer increases in depth to 15 cm. EH, pH, and interstitial Fe and Mn water concentrations are displaced towards 15-20 cm (downwards). Solid-phase Fe and Mn maxima accumulations sharply define lower limits of the oxidized layer. Direct redoxchamical effects of Isoetes on lake and experimental sediments are found to 18-20 cm depth. In controls, Fe and Mn contents increase in uppermost sediment layers to the cost of sediment beneath. (Danovich-Wisconsin)
W80-02521

RAPID EXCHANGE OF OXYGEN BETWEEN PLANT AND WATER,
Freshwater Biological Association, Wareham (England). River Lab.
D. F. Westlake.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2363-2367, 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Metabolism, *Aquatic plants, *Oxygen, *Lacunae, *Plant morphology, *Plant physiology, Gases, Aeration, Light intensity, Water balance, Oxygen demand, Microbiology, Diffusion, Equilibrium, Time, Flow, Oxygen requirements, Photosynthesis, Respiration.

Under stirred or flowing conditions, constant-oxygen rates of change are attained after 4-20 min when plants possess lacunae and quicker when they lack them. This paper describes experiments on rates of oxygen change in water flowing past aquatic plants. specifically the amount of time it takes to reach and maintain steady-state. Plants include Myriophyllum spicatum and Vallisneria americana with lacunae and Fontinalis antipyretica and Cladophora without lacunae. Detectable lags are rare whenever plants are darkened; however, in one experiment with Vallisneria, lags were 4-10 min. Lag times after illumination are significantly shorter for plants without lacunae (2 min) than for those with them (9 min). Constant rates are rarely maintained for more than 20-30 min. In 'saw-tooth' experiments the same high constant rate could be repeated and maintained over 1 h by replacing the water. Rates 2-10 mg 02/g d wt/h are considered rapid. Extracted gas volumes were usually 10-15% of total plant volume. Results for Myriophyllum experiments in light and aerated water were: 3.31 ml gas containing 21.9% oxygen from 20.4 g fr wt. Lacunae in illuminated plants in air-saturated water contain 23% oxygen; internal oxygen concentrations, higher than external levels, fall rapidly when photosynthesis rates decrease. Therefore, resistance to outward diffusion is not high. (Danovich-Wisconsin)
W80-02522

IMPACT OF THE FRESHWATER SPONGE SPONGILLA LACUSTRIS ON A SPHAGNUM BOG-POND,
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
T. M. Frost.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; vol 20, Part 4, 1978, p 2368-2371, 1 Tab, 4 Ref.

Descriptors: *Mud Pond(NH), *Aquatic animals, *Ecology, *Sponges, *Water purification, *Feeding rates, Growth rates, Distribution, Bogs, Environmental effects, Filters, Filtration, Water quality, Regression analysis, Turnovers, Suspended load, Suspended solids, Particle size, Diets, Foods, Metabolism.

Regression equations for Spongilla lacustris in Mud Pond, New Hampshire, March-October 1976, show that these sponges exhibit an average 0.83 ml/sec/g dwt of water cleared at 15.3 C. Thus the total pond sponge population, 148,000 g dwt, eats about 10.7 million 1/d. These are comparable to rates reported for zooplankton communities in bog and oligotrophic lakes. Therefore, in some freshwater systems, sponges significantly contribute to suspension feeding. Mud Pond, a Sphagnum bog-pond, has 5.5 ha surface area, 2.55 m maximum depth, and 1.36 m average depth. S. lacustris average standing crop is 2.67 g dwt/sq m in October. Sponge population is not distributed homogeneously; colonies are rare at depths greater than 1.7 m and also near very shallow areas. S. lacustris exhibits very high growth rates. Sponges implanted on rafts in May have an average 0.014 g dwt; by October sponges have an average 12.52 g dwt. Average feeding rates during laboratory experiments range 0.38-6.59 ml/sec/g dwt with a 2.04 mean. Calculated mean reeding rates for areas less than 1.75 m deep in Mud Pond are 1.46 (June), 1.50 (July), 1.42 (August), 1.19 (September) and 0.84 (October) ml/sec/g dwt. Due to changes in biomass, the percentage of water column cleared per day is 0.91 (June), 3.50 (July), 9.60 (August), 21.2 (September), and 23.1 (October). (Danovich-Wisconsin)
W80-02523

CONTRIBUTION OF ASEXUAL REPRODUCTION TO THE DISTRIBUTION OF TRICLAD FLATWORMS,
Lyon Univ. (France). Dept. of Biology.
E. Patte, and H. Persat.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2372-2377. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Ecology, *Asexual reproduction, *Sexual maturity, *Flatworms, Growth rates, Aquatic animals, Distribution, Reproduction, Animal physiology, Animal behavior, Worms, Turbellaria, Amby River(France), Herault River(France), Algeria, Adaptation, Population, Water temperature, Mortaility, Genetics.

Studies of triclads and sexually-reproducing flatworms from Algeria and southern France show that asexual reproduction extends the range of triclads toward warmer biotopes and affords a competitive superiority in r-selection cases. Despite genetic invariability, clones show some adaptation to their environment. Triclads were reared in fingerbowls at different temperatures under optimal food conditions and life-tables. Polycelis felina, a sexually-reproducing population, were collected from the Amby River, southeastern France. Fertile cocoons (0.0044) are only deposited in a narrow thermal range around 10 c, whereas fission occurs from 10-17.5 C and at higher rates (0.012-0.09). Genetic stocks of clones (Dugesia gonocephala) were obtained from Algeria and the Herault River in southern France. Variances due to temperature, clonee origin, and substrates were computed. Both clones responded in the same manner to substrate. Survival was significantly longer on losses (12.6 h) than with pebbles (8,8 h). Algerian clones surived longer (14.4 h) than French clones (7.7 h), demonstrating that ecophysiological diversity exists among D. gonocephala clones. Temperature-survival curves were statistically straight lines only from 31-34 C. Survival at 30 C was higher. Lethal temperature (24 h) was 31.0 C for the Algerian clone, 30.6 C for the French clone, and 28 C for D. gonocephala from the Amby River. (Danovich-Wisconsin)
W80-02524

REPRODUCTIVE STRATEGIES SHOWN BY FRESHWATER HIRUDINOIDEA,
Calgary Univ. (Alberta). Dept. of Biology.
R. W. Davies.
In: Proceeding: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; vol 20, Part 4, 1978, p 2378-2381. 1 Tab, 9 Ref.

Descriptors: *Leeches, *Reproduction, *Timing, *Lakes, *Alberta, Canada, *Animal behavior, Ecology, Invertebrates, Aquatic animals, Population, Adaptation, Animal physiology, Competition, Life history studies, Life cycles, Breeding, Speciation, Marion Lake, British Columbia, Newsome Pond, Alberta, Jail Pond, Alberta, Cairn Pond, Alberta, Canada.

This paper discusses leech population reproductive strategies in Canadian lakes: Helobdella stagnalis was studied in Marion Lake, Bristish Columbia and Newsome Pond, Alberta; Nephelopsis obscura was studied in Newsome and Jail Ponds, and Erpob punctata in Cairn ajd Jail Ponds, all semi-permanent ponds in Alberta. The most important reproductive factor fo H. stagnalis is temperature in terms of growning season length. Two generations of young are produced annally only if more that 2000 day-degrees occur between release of young and growth cessation. Alberta field and laboratory experiments indicate that where the growing season is short, second generation individuals do not survive. N. obscura in Alberta has two breeding periods, May-June and August-September. N. obscura weight ranges 170-500 mg. If the appropriate size is attained (150 mg) withing 12 months reproduction follows a simple annual cycle; if it is not reached within 12 months, reproduction is delayed. Jail and Cairn Ponds are geographically close and limnologically similar; E. punctata and N. obscura have very similar diets. Therefore, their reproductive strategy differences depend on interspecific competition. With N. obscura absent in Cairn, E. punctata reproduces over two years. In Jail Pond, with N. obscura competition, E. punctata produces young as soon and as rapidly as possible to utilize spring secondary production as soon as N. obscura. Thus in Cairn, E. punctata shows K-selection characteristics but in Jail, shows r-selection. (Danovich-Wisconsin)
W80-02525

FEEDING IN THE ROTIFER BRACHIONUS CALYCIFLORUS (III). DIRECT OBSERVATIONS ON THE EFFECTS OF FOOD TYPE, FOOD DENSITY, CHANGE IN FOOD TYPE AND STARVATION ON THE INCIDENCE OF PSEUDOTROCHAL SCREENING,
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
J. J. Gilbert, and P. L. Starkweather.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische Und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2382-2388. 3 Fig, 3 Tab, 6 Ref. NSF DEB 76-09768.

Descriptors: *Rotifers, *Algae, *Animal behavior, *Food habits, *Particle size, *Feeding rates, Aquatic animals, Foods, Diets, Digestion, Metabolism, Density, Size, Food abundance, Animal metabolism, Mode of action, Animal physiology, Predation, Ecology.

Laboratory experiments on the orientation of pseudotrochal cirri in rotifer exposed to various particle types and concentrations show that Brachionus calyciflorus and probably other rotifers do not ingest food items in proportion to their abundance and can control admission of particles into their buccal field. Pseudotrochal screening, and thus potential clearance rates and feeding efficiencies, are a function of particle type and particle density, and can be modified by previous feeding history. Rhodotorula, even at high densities, rarely induces screening while Euglena induces much screening at high densities and less screening at low densities.

Very small cells, such as Rhodotorual, are regularly taken into the buccal field, independent of density, while larger cell types are increasingly deflected away from the buccal field at high densities. Rotifers transferred from Rhodotorula to Euglena form pseudotrochal screens less than rotifers transferred from Euglena to Euglena. This difference persists 15 min after transfer. Starved individuals rarely form pseudotrochal screens. Screening responses are not simple reflexes and are significantly influenced by previous feeding history, such as whether or not they have been starved or acclimated to other particles. (Danovich-Wisconsin)
W80-02526

FEEDING IN THE ROTIFER BRACHIONUS CALYCIFLORUS IV. SELECTIVE FEEDING ON TRACER PARTICLES AS A FACTOR IN TROPHIC ECOLOGY IN AN IN SITU TECHNIQUE,
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
P. L. Starkweather, and J. J. Gilbert.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2389-2394. 1 Fig, 3 Tab, 18 Ref. NSF DEB 76-09768.

Descriptors: *Rotifers, *Food habits, *Tracers, *Yeasts, *Euglena, *Analytical techniques, *Indicators, *Laboratory tests, Food abundance, Diets, Aquatic animals, Animal behavior, Metabolism, Animal metabolism, Mode of action, Ecology, Animal phsiology, Particle size, Algae.

Brachionus calyciflorus, a pelagic rotifer, can select specific particle types from simple mixtures of suitable foods. However, in these laboratory experiments, no single tracer reliably indicates feeding activities on different particles. For Euglena-fed animals, clearance rates based on algal tracers are 3.49 micro l/animal/hr. But clearance rates based on the yeast tracer are 13.85 micro l/animal/hr. Testing with Rhodotorula-fed rotifers also shows that yeast gives significantly greater clearance rate estimates than when using Euglena. B. calyciflorus is also more efficient at collecting yeast than algae. Using Euglena as primary food, and testing both algal and yeast clearance simultaneously, yeast is removed at a significantly greater rate. Using the yeast tracer alone to estimate feeding results in a 160% overestimation in clearance and hourly Euglena rations. Of great interest for rotifer trophic ecology is the indication that feeding history affects food selectivity. With yeast as the primary food, yeast-cultured animals feed on Rhodotorula preferentially whereas Euglena-cultured rotifers prefer Euglena, even though they acclimated in similar suspensions for one hour. (Danovich-Wisconsin)
W80-02527

EFFECTS OF ALGAE AND PROTOZOANS ON THE DYNAMICS OF POLYARTHRA VULGARIS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
A. L. Buikema, Jr., J. D. Miller, and W. H. Yongue, Jr.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2395-2399. 4 Fig, 16 Ref.

Descriptors: *Rotifers, *Population, *Pandapus Pond,(VA), *Food abundance, *Animal physiology, *Animal behavior, Ecology, Biological communities, Algae, Protozoa, Reproduction, Fertility, Fecundity, Foods, Diets, Food habits, Productivity, Vitamins, Water temperature, Mountains competition.

Polyarthra vulgaris (rotifer) populations in Pandapas Pond, Virginia are influenced by: high temperatures (>23C) which affect survival and retard production; proper food availability; availability of soluble vitamins and ability to compete for them especially B-12; and antibiosis by various algae and protozoa. Pandapas Pond is a shallow impoundment located at 664.8 m altitude in Jefferson National Forest, with 32,376 sq m surface area, and 3 m maximum depth. Polyarthra numbers, in addition to characteristic spring and fall maxima, peak in late November-December. The highest density (1169/1) occurred in December when temperatures were 2.8C. Polyarthra feeds primarily on Dinobryon, especially D. sertularia and D. divergens, Cryptomonas erosa, and Chilomonas. Total euglenoid densities correlate with Polyarthra peaks when euglenoid densities exceed 200,000/ml. While Polyarthra rarely feeds on euglenoids, Polyarthra required soluble vitamin B-12 for successful egg production and hatching and euglenoids are B-12 indicators. The late fall Polyarthra peak corresponds with fall abscission of leaves; leachates from plant materials containing soluble vitamins are partially responsible for Polyarthra dynamics. Precipitous declines in Polyarthra populations in early August correspond to Eudorina blooms and temperatures in excess of 25C. In August and September, blue-green algal blooms inhibit Polyarthra. When Monas, Synura, Mallomonas and blue-green algae occur in large numbers, the percentage of Polyarthra females carrying eggs declines. (Danovich-Wisconsin)
W80-02528

INFLUENCE OF FLUCTUATING TEMPERATURE ON PLANKTON ROTIFERS. II. LABORATORY EXPERIMENTS,
Biological Station, Lunz am See (Austria).
A. Ruttner-Kolisko.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2400-2405, 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Rotifers, *Temperature, *Life history studies, *Laboratory tests, Plankton, Reproduction, Cultures, Neusiedlersee, Austria, Growth rates, Asexual reproduction, Population, Clones, Standing crops, Thermal stress, Metabolism, Animal physiology.

Hexarthra fennica populations in exponential growth phase with all other environmental factors constant react to fluctuating temperature in agreement with theoretical models, temperature oscillations tend to shorten egg development time and to prolong the interval between eggs. At constant temperature, deposited egg development time, dependent solely on temperature, deviates only minimally from calculated mean values for the whole female life span. Average clone growth rate is 60% during the day and 20% at night, in full agreement with theoretical schedules postulating a 3:1 oscillating egg deposition ratio. However, Hexarthra populations display identical gradients for growth curves at constant and fluctuating temperatures; this is inconsistent with theoretical expectations and with results of other recent studies. This result may be connected with experiments carried out in unrestricted environments rather than the steady-state situation used by others in literature data. Hexarthra is a planktonic rotifer originating from Neusiedlersee, Austria. Laboratory cultures were acclimatized for three days to 24-hour temperature oscillations of 10 C (18 C at 2 hr, 28 C at 14 hr) under constant light conditions. (Danovich-Wisconsin)
W80-02529

GROWTH RATES OF DREISSENA POLYMORPHA PALLAS UNDER LABORATORY AND FIELD CONDITIONS,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
N. Walz.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2427-2430, 7 Ref, 3 Fig.

Descriptors: *Lake Constance, West Germany, *Mussels, *Food abundance, *Growth rates, *Laboratory tests, Aquatic animals, Foods, Diets, Food habits, Biochemistry, Nutrients, Nutrient requirements, Carbon, Phytoplankton, Filter feeders, Population, Algae, Feeds, Mollusks.

As shown by differences between in-situ (Lake Constance, West Germany) and standard laboratory growth of Dreissena polymorpha, a filter-feeding freshwater mussel, particle concentration alone does not define food quality with respect to growth; further information on intake, assimilation and algal biochemical composition is required. Laboratory experiments were calculated as based on temperature and food concentrations actually present in Lake Constance during 1974. Comparing experimental to field growth rates shows much in common but also uncovers a few meaningful deviations. The first actual phytoplankton maximum (Rhodomonas) in April leads to considerably higher laboratory growth rates than expected under standard conditions. In contrast, Stephanodiscus hantzchii mass development in May (up to 4 mg C/1 from winter 0.1 mg C/1) is not exploited by mussels in lake water tanks. In standard laboratory procedures with alga Nitzschia actinastroides at 4 mg C/1 concentrations, 2% growth rate per day occurs. However, physiological activity, in-situ and under constant standard conditions, is comparable only after laboratory results are recalculated to discover environmental factors which previously never were considered. For example, food biochemical composition is crucial for growth. An insufficiency of a single amino acid can hinder growth. Mussels on mixed phytoplankton diets grow better than those fed with single constitutents alone. Assimilation also is important; standard alga Nitzschia is poorly assimilated (41%) by Dreissena. (Danovich-Wisconsin)
W80-02531

OCCURRENCE AND DYNAMICS OF DREISSENA POLYMORPHA (PALL.) (BIVALVIA),
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
A. Stanczykowska.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2431-2434, 2 Tab, 17 Ref.

Descriptors: *Mollusks, *Lake Milolajski, Poland, *Population, *Organic matter, *Cycling nutrients, *Ecological distribution, Bivalves, Mussels, Distribution, Filtration, Seston, Sedimentation, Ecology, Ecosystems, Mortality, Larval growth stage, Life history studies, Life cycle, Biomass, Productivity, Food webs.

Dreissena polymorpha is one of the most common European bivalve mollusks; however, decisive factors are not available for explaining density and population dynamics. Quantitative D. polymorpha occurrence in lakes is mainly determined by mortality rate in the settling larvae and postveliger state, while individual size and weight are controlled by trophic conditions. Postveliger stage mortality can reach 99% due to unsuitable bottom conditions. Bigger and heavier D. polymorpha occur in high trophic environments. However, D. polymorpha populations changes in density, size and weight affect lake organic matter budgets. During passage through mollusks, seston become saturated with mucus and enriched with bacteria, constituting valuable food for benthic invertebrates. Large biomass, long life cycle (5 years), and extremely long decomposition periods (20 years) mean that D. polymorpha populations store enormous amounts of organic matter and calcium carbonate. Nevertheless, for an ecosystem, filtration ability which can reach 1 l/d, is much more important than biomass production. In Lake Mikolajskie, Poland, with 2,000 ind (D. polymorpha)/sq m, seston consumption amounts to 9% pelagic primary production; feces reach 13% annual sedimentation. At higher densities, mollusk activity is crucial in determining lake organic matter cycling. In many lakes, D. polymorpha accelerates organic matter circulation, modifies the seston and sediment environment, and provides an important link in food webs. (Danovich-Wisconsin)
W80-02532

DISTRIBUTION AND BIOLOGY OF SOME NEARCTIC TUNDRA POOL PHYLLOPODS,
Acadia Univ., Wolfville (Nova Scotia). Dept. of Biology.
G. R. Daborn.
In: Proceedings: Congress in Denmark 1977, Inter-

nationale-Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2442-2451, 5 Fig, 1 Tab, 31 Ref.

Descriptors: *Crustaceans, *Tundra, *Ponds, *Spatial distribution, *Shrimp, Invertebrates, Arctic, Subarctic, Habitats, Distribution, Ecological distribution, Baffin Island, Somerset Island, Biological communities, Food abundance, Foods, Zooplankton, Benthic fauna, Substrates, Ecology, Ecotypes.

Phyllopod investigations of Baffin and Somerset Islands, in the North American Arctic, August-September 1975, reveal that sporadic occurrence of many tundra pool crustaceans does not simply result from chance locations but may be attributed to a precisely suitable foodsupply. Dominant macroscopic zooplankters are usually phyllopods: either Branchinecta paludosa, Artemiopsis stefanssoni, Daphnia middendorffiana, Diaptomus eiseni or Diaptomus minutus. Branchinecta paludosa is holarctic ly distributed and is a typical tundra pool inhabitant; it is also recorded in several extralimital records in Alberta, Canada. Another fairy shrimp, Artemiopsis stefanssoni, occurs across arctic Canada and west Greenland with a single extralimital record in Alberta. These extralimital records are probably related to arctic waterfowl migratory patterns. Co-occurrence of two fairy shrimp species is not often recorded at lower latitudes, except where species form a predator-prey association. However, Artemiopsis and Branchinecta are usually spatially separated even in shallow pools. Artemiopsis usually remains near the water surface while Branchinecta swims close to rock or boulder bottom surfaces. Limb morphology and gut contents show that Artemiopsis is a suspension feeder while Branchinecta, deposit feeder. Small pools in bedrock tend to harbor suspension feeders such as Artemiopsis while tundra pools surrounded by sedge meadows and with a detritus bottom layer, exhibit Branchinecta communities. (Danovich-Wisconsin)
W80-02533

DISTRIBUTION AND ECOLOGY OF SVALBARD'S CLADOCERA,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.).
S. Husmann, H. U. Jacobi, M. P. D. Meijering, and B. Reise.
In: Proceedings: Congress in Denmark 1977, Internationale-Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2452-2456. 2 Fig, 14 Ref.

Descriptors: *Svelbard, *Arctic, *Crustaceans, *Daphnia, *Ecological distribution, Distribution, Ecology, Invertebrates, Population, Speciation, Cold regions, Greenland, Habitats, Niches, Biomes, Biological communities, Ecotypes, Pelagic zone, Interstitial water.

During two limnological expeditions to Svalbard (Norwegian Islands in the Arctic Ocean) in 1971 and 1975, Cladocera populations were investigated on Bear Island and Spitsbergen. All Cladoceran sampled in more than 100 sites belong to five species: Daphnia pulex, Daphnia longispina, Macrothrix hirsuticornis, Chydorus sphaericus, and Acroperus harpae. D. pulex shows a high morphologic variability in the Arctic. It occurs in all icefree coastal plains on the main islands. Populations are often fairly large and settle in pelgagic areas of ponds, shallow lakes and beta-oligohaline lagoons. Deeper lakes which usually contain fish, are avoided. D. longispina occurs sporadically in the 43 m deep Ellasjo on Bear Island. M. hirsuticornis is present on all coasts; it occurs up to 122 m above sea level (Bear Island) and settle in interstitial waters and in beta-oligohaline lagoons. C. sphaericus is distributed like D. pulex although it lives in interstitial water on sand and moss along lakes, ponds, and brooks. A. harpae if found in interstitial water in sand and moss along bigger lakes and small rivers. Alona guttata mentioned in 1917 studies, was not found. The limnological and biogeographic situation with respect to cladoceran species distribution limits in Greenland north of 74 N and in Svalbard is nearly identical. Species are closely related to the same latitudes in both regions even though Svalbard, unlike Greenland, is influenced by the Atlantic Gulfstream. (Danovich-Wisconsin)
W80-02534

WHY DO LARGE ZOOPLANKTON SPECIES DOMINATE.,
Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.
C. E. Goulden, L. Hornig, and C. Wilson.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2457-2460. 2 Tab, 12 Ref.

Descriptors: *Fecundity, *Crustaceans, *Dominant organisms, *Size, *Zooplankton, *Population, *Growth rates, Reproduction, Daphnia, Invertebrates, Competition, Predation, Productivity, Growth stages, Mature growth stage, Sexual maturity, Ecology, Ecosystems.

This paper proposes that in the absence of intense size-selective predation by fish, large cladoceran species dominate because of greater reproductive rates, measured by the intrinsic rate of natural increase (r.). This hypothesis is applied only to Cladocera and not to all zooplankton species. Species population growth rate is important in determining competition outcomes. The major reproduction components that determine r are time of first birth and fecundity. Large Daphnia species have large clutch size; many species commonly produce 30-40 young at each birth. Smaller Cladocera, exemplified by bosminids, have maximum size broods of 8-12 young. Within Cladocera, large species carry many small eggs while small species carry few large eggs. R-max was estimated for three species, Daphnia galeata mendotae, Daphnia ambigua and Bosmina longirostris. Even though Bosmina matures earlier (5.18) than either Daphnia species (6.13 and 7.46) higher fecundities of the latter (7.66 and 5.23 for Daphnia and 1.47 for Bosmina) are sufficient to produce a significantly higher r-max (.381 and .385 for Daphnia compared to .315 for Bosmina). Body size (length) positively correlates with r. Further experiments to test the hypothesis are being conducted. (Danovich-Wisconsin)
W80-02535

INFLUENCE OF PREY SIZE, LIGHT INTENSITY, AND ALTERNATIVE PREY ON THE SELECTIVITY OF PLANKTON FEEDING FISH,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
J. Jacobs.
In: Proceedings; Congress in Denmark 1977, Internationale-Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2461-2466. 3 Fig, 21 Ref.

Descriptors: *Predation, *Size, *Light intensity, *Crustaceans, *Ecology, *Laboratory tests, Waterfleas, Niches, Zooplankton, Fish, Light, Distribution, Competition, Mortality, Daphnia, Ecosystems, Selectivity, Light penetration, Euphotic zone, Habitats, Fish food organisms, Food.

Laboratory experiments dealing with prey size, alternative prey, and light intensity reveal at least three cooperative and light-dependent effects which help determine size-dependent selection: (1) detection by mechanical means or chance contact; (2) visual detection, with a threshold at low light intensities and an upper limit of predation rate; and (3) true selection based on central nervous choice after visual comparison. These three effects depend on varying light intensities. At very low light intensities or in darkness, mechanical detection is dominant; differential mortality is proportional to prey size. As light gradually increases, visual detection is reached for larger prey. Simultaneous small prey detection is negligible, resulting in strong relative large prey mortality. As light becomes brighter, both prey types are easily seen and caught, resulting in continued strong selection based on central nervous differentiation. Which effect dominates under natural conditions depends on lake depth and transparency, fish light sensitivity and visual acuity, actual prey size, and vertical zooplankton and fish distribution, and the time of day. These relationships have certain ecological implications: Waterfleas tend to live and feed in the dark; larger and older forms live in lower layer than smaller forms. Smaller prey are also at an advantage in the same spatial niche as larger prey. Whenever mortality by fish outweights productivity(summer), niche overlap would be favored by smaller species. (Danovich-Wisconsin)
W80-02536

ULTRAVIOLET TOLERANCE OF PLANKTONIC CRUSTACEANS,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
O. Siebeck.
In: Proceedings: Congress in Denmark 1977, Internationale-Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2469-2473. 2 Fig, 7 Ref.

Descriptors: *Daphnia, *Crustaceans, *Color, *Ultraviolet radiation, *Resistance, Invertebraies, Light intensity, Plankton, Predation, Pigments, Adaptation, Environmental effects, Speciation, Ecology, Mountains, Mountain lakes, Mortality, Stress, Light, Solar radiation, Photoactivation, Bavaria, West Germany.

Field experiments show that Daphnia pulex obtusa from mountain puddles tolerates higher radiation doses than Daphnia galeata and Daphnia longispina which inhabit lowland lakes; the higher tolerance is due to different ultraviolet intensities. Both cladocerans and copepods exhibit marked coloring in water in mountain regions. By contrast, cladocerans and copepods in clear water lakes are often colorless and transparent. Transparency and color absence serve as protection from various predators, but planktonic crustaceans from mountain pools and puddles exhibit marked coloring. Experiments were performed on D. pulex obtained from shallow mountain puddles and exhibiting a light brown color, and on D. galeata and D. longispina, obtained from deep Bavarian lakes and colorless. Similar-size animals were exposed to direct sunlight in Munich (490 m a.s.l.) in small glass dishes. After six 6 h, all D. galeata and D. longispina had died, while almost all D. pulex were alive. After 8 h, some D. pulex died as well. When dishes were covered with glass plates, mortality was conspicuously lower: all D. pulex survived while losses among D. galeata and D. longispina were also markedly lower, demonstrating that mortality is predominately due to ultraviolet radiation. Mean lethal dose for D. pulex amounts to 0.77 Ws/sq cm and 0.49 Ws/sq cm for D. galeata. (Danovich-Wisconsin)
W80-02537

INCORPORATION RATES OF SIMOCEPHALUS VETULUS SCHOEDLER AS INFLUENCED BY FOOD SIZE,
Windsor Univ., (Ontario). Dept. of Biology.
L. Bevan, J. M. Winner, and D. G. Wallen.
In: Proceedings: Congress in Denmark 1977, Internationale-Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2474-2478, 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Foods, *Size, *Feeding rates, *Algae, *Crustaceans, Food abundance, Productivity, Tracers, Food habits, Animal behavior, Nutrients, Zooplankton, Cultures, Ecology, Carbon, Laboratory tests, Selectivity.

Studies investigating carbon incorporation rates of a littoral cladoceran, Simocephalus vetulas show that this crustacean selectivity grazes on the larger Euglena gracilis with Chlamydomonas reinhardti as second choice. In unialgal cultures, S. vetulus incorporation rates are asymptotic, increasing linearly to a maximum rate with increasing ration concentration. The incipient limiting concentration for assimilation rates varies with different algal species. These values are inversely proportional to algal ration diameter, being 12,000 cells/ml for Chlorella vulgaris, 10,000 cells/ml for Chlamydomonas, and 5,000 cells/ml for Euglena. Maximal assimilation rates are 0.0728 micro g C/ind h for Chlorella, 0.0859 micro g C/ind h for Chlamydomonas, and 0.1074 micro g C/ind h for Euglena. S. vetulus, fed on mixed algal rations, with one spe-

cies labelled with radioactive carbon, incorporates carbon (C) at rates proportional to algal size. When Euglena is the labelled species, incorporation rates are 0.1317 micro g C/ind h. Rates for Chlamydomonas (0.0698 micro g C/ind h) and Chlorella (0.0104 micro g C/ind h) are lower. Diameters of the three species are 2.8 micro m (Chlorella), 5.5 micro m (Chlamydomonas) and 13.7 micro m (Euglena). Even though S. vetulus C incorporation rates are higher when feeding on Euglena in unialgal cultures, efficiency measurements comparing C incorporation rates to total C amounts available show that Chlorella is used 20 times more efficiently than Euglena and three times more efficiently than Chlamydomonas. (Danovich-Wisconsin)
W80-02538

POPULATION REGULATION OF THE CHYDORIDAE IN LAKE ITASCA, MINNESOTA,
Tennessee Univ., Knoxville. Dept. of Zoology.
J. B. Williams, and M. C. Whiteside.
In: Proceedings: Congress in Denmark 1977, Internationale-Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2484-2489, 2 Fig, 15 Ref. NSF BMS 72-00079.

Descriptors: *Population, *Lake Itasca(MN), *Crustaceans, *Food webs, *Ecology, Zooplankton, Invertebrates, Growth rates, Reproduction, Mortality, Littoral, Predation, Distribution, Laboratory tests, On-site investigations, Fish food organisms, Productivity, Balance of nature, Distribution patterns.

Field and laboratory experiments on chydorid populations in Lake Itasca, Minnesota April 1975-August 1976, show that the characteristic summer population crash is due not to decreases in chydorid birth rates but to increases in chydorid deaths due to predation. Lake Itasca is located in north central Minnesota with a 436 ha surface area; 55% of the lake is littoral. The five most abundant Chydoridae are Chydrous sphaericus, Alonella excisa, Pleuroxus denticulatus, Acroperus harpae, and Alonella nana, whose combined numbers represent 80% of total Chydroidae. The population is always over-dispersed. Chydorus populations peak in late spring or early summer. C. sphaericus and P. denticulatus also have midwinter peaks. Population numbers of all five species crash to very low numbers immediately following their summer peaks. In order to determine population control mechanisms, birth rates were estimated by Edmondson egg ratio techniques. Chydorus, Pleuroxus, Acroperus, and A. nana populations were observed. Those protected populations from predation in Biomonitors showed continuous growth, while unprotected populations crashed to low levels. Chydorids are part of a complex food web involving littoral and limnetic species. Chydorids are found in the digestive system of many fish and also Chaoborus, Chironomus, and Odonata nymphs. (Danovich-Wisconsin)
W80-02539

MORPHOLOGICAL AND BEHAVIORAL INTERACTIONS BETWEEN A CARNIVOROUS AQUATIC PLANT (UTRICULARIA VULGARIS L.) AND A CHYDOID CLADOCERAN (CHYDORUS SPHAERICUS O.F.M.),
Wisconsin Univ., Madison. Dept. of Zoology.
D. G. Meyers, and J. R. Strickler.
In: Proceedings: Congress in Denmark 1977, Internationale-Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2490-2495, 1 Fig, 2 Tab, 18 Ref. NSF DEB 76-02096.

Descriptors: *Ecology, *Littoral, *Crustaceans, *Aquatic plants, *Symbiosis, *Mode of action, *Diurnal, Invertebrates, Zooplankton, Foods, Predation, Substrates, Movement, Animal behavior, Plant physiology, Plant morphology, Food habits, Distribution, Microenvironment, Grazing, Filter feeders.

This paper describes associations between Chydorus sphaericus O.F.M., a chydorid cladoceran and Utricularia vulgaris L., a carnivorous, aquatic plant that serves as both a substrate and predator to chydorids. Experiments on chydorid activity patterns reveal distinct diurnal activity differences; chydorids move both farther and faster during the day, greater numbers are captured by Utricularia at night. Utricularia predominantly captures slower moving grazing animals; and at night 60% of the active chydorids move less than 1 sec compared with 30% during daytime. Chydorid motion at night is active grazing, with more animals attached to Utricularia as a substrate and, consequently, a higher probability of animals contacting utricularia bladder doors which lead to capture. During the day, chydorid populations have less actively grazing individuals. Swimming speeds are faster and animals move more directly from one resting spot to another. When perched on Utricularia antennae or bristles, chydorids are not passive but are actively filter-feeding. These studies on chydorid microdistribution and vertical migration strongly contradict previous hypotheses of littoral ecology. (Danovich-Wisconsin)
W80-02540

A PREDATION MODEL OF ZOOPLANKTON COMMUNITY STRUCTURE,
Washington Univ., Seattle. Dept. of Zoology.
T. M. Zaret.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2496-2500, 2 Fig, 2 Tab, 16 Ref. NSF BMS 74-122282.

Descriptors: *Predation, *Model studies, *Fish, *Zooplankton, *Biological communities, *Lakes, *Swedish, Mathematical models, Crustaceans, Invertebrates, Size, Ecology, Ecotypes, Animal behavior, Curves, Competition, Nutrients, Food habits, Foods, Fish behavior, Fish food organisms.

A predation model based on predictions of limnetic zooplankton assemblages from knowledge of predators present in any lake system, confirms that predation and competition are of ultimate importance in structuring elements of freshwater systems. The model tested with data from northern Swedish lakes, is based on interactive relations between two dominant classes of freshwater predators. Class I, gape-limited predators, is best characterized by an electivity curve which increases with prey attractibility. The most important Class I predators are fish. Class II or size-dependent predators, select prey according to body-size. This electivity curve is bell-shaped; predators include crustaceans such as cladocerans, copepods, and also rotifers. Using an interactive approach, the model predicts: (1) In the absence of Class I predators, Class II predators are dominant and zooplankton prey assemblages are dominated by large herbivorous species. (2) As Class I predation increases, large herbivores, are replaced by medium-size ones. (3) With still-increasing Class I predators, medium-size herbivores are replaced by smaller ones. (4) As Class I predation becomes more intense, dominant herbivores are replaced by still smaller ones and Class I consumption of Class II predators results in a gradual transition to smaller-sized invertebrates predators. (Danovich-Wisconsin)
W80-02541

STRATEGIES FOR CO-EXISTENCE IN TWO LIMNETIC CYCLOPOID COPEPODS,
Freshwater Biological Association, Ambleside (England).
W. J. P. Smyly.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2501-2504, 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Ecology, *Copepods, *Competition, *English Lake District, United Kingdom, Crustaceans, Invertebrates, Water temperature, Distribution, Population, Speciation, Depth, Thermocline, Limnetic zone, Habitats.

Studies of two limnetic cyclopoid copepod species, Cyclops abyssorum and Mesocyclops leuckarti in the English Lake District show temporary increases in annual abundance of the scarcer species; however, in the long-term, one species will predominate and exclude the other. In Britain, C. abyssorum is rare in the south; M. leuckarti is rare in the north. The English Lake District, located in the northwest, is an area where species overlap. C. abyssorum is widely distributed, whereas M. leuckarti is limited to the Windermere drainage area and a northern valley. C. abyssorum instars are larger than corresponding M. leuckarti instars. Mean annual abundance values in Esthwaite Water (1956-1971) show M. leuckarti as the more numerous species (60,000-100,000 ind/sq m). C. abyssorum is comparatively scarce (10,000-20,000 ind/sq m) except for the period from 1963-1968 (20,000-50,000 ind/sq m), following an exceptionally cold period. In Rydal Water where C. abyssorum is dominant, M. leuckarti is found only briefly. These results show that even in warmer, shallow lakes, C. abyssorum can regain abundance, if only temporarily, in a lake dominated by M. leuckarti, and at least in one lake, be the dominant species. When Windermere is isothermal, both species are evenly distributed vertically; during thermal stratification, C. abyssorum inhabits deeper waters. In cold months, although vertical overlap is extensive, population densities are low, and competition interactions probably minimal. (Danovich-Wisconsin)
W80-02542

PREY SELECTION BY THE CYCLOPOID COPEPODS MESOCYCLOPS EDAX AND CYCLOPS VICINUS,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
Z. Brandl, and C. H. Fernando.
In: Proceedings: Congress in Denmark 1977, Internationale Veneinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2505-2510, 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Predation, *Size, *Copepods, *Food webs, *Ecosystem, *Animal behavior, Ecology, Foods, Food abundance, Zooplankton, Food habits, Diets, Density, Speciation, Crustaceans, Rotifers, Growth stages, Larvae, Feeding rates, Daphnia.

Both Cyclops vicinus and Mesocyclops edax predatory feeding is selective depending on prey species; within species, feeding relates to on specimen size. However, size is not always decisive for preference of some rotifer species. Large Applanchna is more commonly selected than small Keratella cochlearis. Predation is also dependent on prey species density. C. vicinus and M. edax prey include practically all species of rotifers, copepods, and cladocerans coexisting with predators. Both predators are generally similar in their feeding. C. vicinus and M. edax clearly prefer certain prey species. Diets mainly consist of rotifers, copepods larvae, and some cladocerans. Various rotifers, especially Polyarthra, and calanoid copepod larvae constitute a much higher proportion of captured prey than their corresponding percentage in zooplankton. Other species such as cyclopoid copepod naupliar larvae, larvae of the predator itself and rotifer Keratella cochlearis, are important diet components, however, their importance in the diet closely corresponds to that in zooplankton assemblages. Predation is also selective upon smaller speciemens of a given prey species. Predation rate is three times higher on smaller Brachionus angularis from two summer rates. (Danovich-Wisconsin)
W80-02543

EQUIVALENCE OF COPEPOD AND INSECT DIAPAUSE,
Olso Univ. (Norway). Inst. of Zoology.
K. Elgmork, and J. P. Nilssen.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2511-2517, 3 Fig, 1 Tab, 21 Ref.

Descriptors: *Copepods, *Dormancy, *Norway, *Lakes, *Bottom sediments, *Diapause, *Growth stages, Invertebrates, Crustaceans, Zooplankton, Lake sediments, Animal physiology, Photoperiodism, Depth, Animal behavior, Metabolism, Life

cycles, Physiological ecology, Population, Ecology, Aquatic insects.

Bottom lake sediments from many Norwegian localities were investigated for cyclopoid emergence rates; diapause phase sequence corresponds in detail to that for insect diapause. These findings support the theory that dormancy phenomena in insects and cyclopoid copepods are governed essentially by the same physiological processes. Active penetration or the presence of resting stages relatively deep in bottom sediments indicates diapause in copepods. Older instars occur somewhat deeper in sediments. Most dormant copepodids are situated in the uppermost 2.5 cm mud layers. Fractions of the populations are, however, found as deep as 10 cm. Diapause includes preparatory, induction, refractory, activated, and termination phases. Preparation for dormancy is clearly present in freshwater cyclopoids; instars accumulate in water layers above bottom sediments. During induction, a rapid and marked increase in dormancy occurs. During refractory phases, intensity and duration varies. Deepest torpor was observed in Cyclops stenuus (20 cm) in a shallow pond during an exceptionally hot summer. Activation is indicated by gradually rising curves; torpidity is now diminished. Termination is characterized by practically all resting phase stages leaving the sediments; this phase is very short and usually occurs in spring. Growth, development, and reproduction are immediately resumed. (Danovich-Wisconsin)
W80-02544

LIFE CYCLE STRATEGIES IN NEIGHBOURING POPULATIONS OF THE COPEPOD CYCLOPS SCUTIFER SARS,

Olso Univ. (Norway). Inst. of Zoology.
K. Elgmork, J. P. Nilssen, T. Broch, and R. Ovrevik.

In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2518-2523, 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Life cycles, *Copepods, *Norway, *Lakes, *Predation, *Abiotic environment, Crustaecans, Zooplankton, Diapause, Ecology, Population, Growth stages, Dormancy, Photoperiodism, Animal physiology, Physiological ecology, Metabolism, Life history studies, Environmental effects, Fish, Seasonal.

Variation in life cycle patterns of Cyclops scutifer in five Norwegian lakes is difficult to explain by abiotic factors; while fish predation better explains observed cycles, discrepancies also exist with this hypothesis. Five C. scutifer populations were compared in five southern Norway lakes less than 3 km apart and in the same watershed. Three lakes exhibit one-year cycles; two have a partial two-year cycle. Dormancy is present in only one population. Reproduction takes place in early summer in three lakes and occurs throughout summer in two lakes. Nauplii produced during summer can either postpone or directly proceed with development. Great variations in C. scutifer seasonal cycles occur in a restricted area with the same climate and photoperiodicity. Possible regulatory factors are therefore most likely restricted to the lake or parts of the lake. One particular problem is the diapausing population; this particular lake shows no special environmental factors, being medium in size, depth, oxygen and humic contents. Generally, abiotic factors seem unrelated to life cycle patterns. By comparing life cycles and fish predation, both populations with a partial two-year cycle occur in communities with high fish predation. However, other lake populations do not fit this hypothesis; factors other than predation are obviously in operation. (Danovich-Wisconsin)
W80-02545

COPEPODA AND CLADOCERA COMMUNITIES IN A RIVER-SWAMP SYSTEM,

Indiana Univ. at Bloomington. Dept. of Biology.
M. W. Binford.

In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2524-2530. 1 Fig, 4 Tab, 11 Ref 14-16-008-767.

Descriptors: *Biological communities, *Zooplankton, *Habitats, *Rivers, *Swamps, *Atchafalaya River(LA), Crustaceans, Copepods, Invertebrates, Tributaries, Lotic environment, Lentic environment, Distribution, Distribution patterns, Ecological distribution, Statistics, Statistical methods, Correlation analysis, Dissolved oxygen, Speciation, Ecosystems.

Copepods and cladoceran plankton assemblage composition among different habitats along the Atchafalaya River, Louisiana, was investigated September 1973-1974. Atchafalaya, a distributary of the Mississippi River, is a complex of rapidly changing environments. Its basin is 173 km long with average 29 km width, covering 5180 sq km in south central Louisiana. Thirty-four taxa account for more than 95% of all specimens. Hotelling-Lawley's Trace statistical test reveals three significant habitat differences: (1) lotic vs lentic; (2) main river vs distributary channels; and (3) upper swamp vs lower swamp. Only one species, Diaptomus pallidus, is a distributary form. Eleven species including Ceriodaphnia quadrangula and Eurytemora affinis are found in both rivers and distributaries. Diaphanosoma leuchtenbergianum, Daphnia parvula, and three other species occur primarily in rivers. five taxa including Diaphanosoma brachyurum and Ilyocryptus spinifer, are swamp forms. Four species could not be assigned to habitats because no pattern was evident. Seven species are ubiquitous. Bosmina longirostris is the most widespread and abundant organism. Assemblages are based on habitat preference and not actual cooccurrence. Two factors may govern habitat preference; Twelve of the 16 river, distributary, and river-distributary species statistically correlate with dissolved oxygen. Secondly, swamp taxa are generally more littoral, while river and distributary forms and more pelagic. (Danovich-Wisconsin)
W80-02546

INSTAR-SPECIFIC SWIMMING PATTERNS AND PREDATION OF PLANKTONIC COPEPODS,

Georgia Univ., Athens. Dept. of Zoology.
J. Gerritsen.

In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2531-2536. 4 Fig, 1 Tab, 17 Ref. NSF DEB 76-02096.

Descriptors: *Copepods, *Predation, *Midges, *Swimming, *Animal behavior, *Period of growth, Zooplankton, Crustaceans, Larvae, Ecology, Growth stages, Physiological ecology, Mode of action, Food habits, Immature growth stage, Juvenile growth stage, Larval growth stage, Mature growth stage, Animal physiology, Life history studies, Size, Mortality, Diurnal.

Laboratory experiments using larvae Chaoborus as predators and Cyclops scutifer as prey demonstrate that planktonic animals, through behavioral and morphological ontological development, are susceptible to different kinds of predators at different stages in their lives. Animals were collected from Fuller Pond, Connecticut and from Lake Heney, Quebec, Canada. Cyclops show considerable changes in swimming behavior during ontogeny. Nauplii remain virtually motionless and only occasionally make short hops. When disturbed they make rapid sinking movements of 1 cm or more. First stage copepodites (CI) exhibit hop-and-sink swimming patterns but have slow sinking speeds and make nauplii-like escape leaps. Copepodites CII, CIII, CIV and adult males all show similar, moderate swimming speed (0.5.2mm/s), while CV and adult females have faster swimming speeds (2-4mm/s). These stages all show characteristic hop-and-sink patterns and flap the abdomen during rapid escape. C Scutifer are more active during the day than at night. Adult Cyclops have lower probabilities of being captured by Chaoborus than do juveniles; however, adults and juveniles suffer higher predation rates than nauplii. Nauplii, which move hardly at all, cause few disturbances in the water to advertise their presence, and thus have three advantages: (1) low encounter rates with predators; (2) effective decrease of vibration-sensitive predator's encounter radii by cryptic movements, and (3) low energy use by not employing hop-and-sink behavior. (Danovich-Wisconsin)
W80-02547

ASPECTS OF THE ZOOGEOGRAPHY OF AUSTRALIAN MICROCRUSTACEANS,

Monash Univ., Clayton (Australia). Dept. of Zoology.
I. A. E. Bayly, and D. W. Morton.

In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2537-2540, 2 Tab, 18 Ref.

Descriptors: *Crustaceans, *Distribution, *Systematics, *Speciation, *Geographical regions, *Australia, *Ecological distribution, Distribution, Patterns, Microorganisms, Zooplankton, Copepods, Microenvironment, Invertebrates, Varieties, Geology, Geologica control, Geological history, Ecology, Ecosystems.

This review increases the number of known cyclopoid species in Australia from 18 to 44 and involves 17 new species. Australian fauna consists predominantly (60%) of endemic species. A new genus, which is similar to Acanthocyclops, contains three species, Genus Microcyclops furnishes over 40% of total endemics and one-third total Australian cyclopoid copoepod fauna. Mixocyclops, Paracyclops and Halicyclops are further genera containing mainly endemic species. Other genera include Mesocyclops, Macrocyclops, Tropocyclops, Eucyclops, and Ectocyclops. Some taxa which contain cosmopolitan species may also contain other species which are highly restricted; species distribution within such taxa may be of considerable biogeographical significance. The genus Boeckella is restricted to the southern hemisphere (Australia, New Zealand, and South America), with one exception: B. orientalis occurs in Mongolia and Manchuria. Crawford's revised view concerning the present distribution of former Gondwanaland portions, makes this otherwise mysterious biogeographical distribution more comprehensible. B. triarticulata is the commonest and most widely distributed boeckellid in Australia. Distribution of Daphniopsis, which occurs in Tibet, Mongolia, Australia, and Antarctica, is also explained by Crawford's reconstruction. (Danovich-Wisconsin)
W80-02548

CAROTENOID PHOTOPROTECTION IN DIAPTOMUS KENAI,

Rhode Island Univ., Kingston. Dept. of Zoology.
N. G. Hairston, Jr.

In: Proceedings: Congress in Denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2541-2545. 1 Fig, 1 Tab, 16 Ref. ERDA AT(45-1)-2225-T23.

Descriptors: *Pigments, *Color, *Copepods, *Findly Lake(WA), *Upper Findley Pond(WA), Light, Light intensity, Light penetration, Biochemistry, Photoactivation, Mortality, Predation, Depth, Animal physiology, Metabolism, Crustaceans, Zooplankton, Proteins, Animal behavior.

Experiments on copepods from clear mountain lakes in Washington conclude that carotenoid pigments provide photoprotection; copepods containing large pigment amounts survive near the lake surface where food is abundant and sunlight most intense, while those containing little pigment must reside at greater depths. Diaptomus kenai bright-red copepods were collected from Findley Lake (9.0 ha) while bluesky individuals were obtained from Upper Findley Pond (0.68 ha) in August, 1976. Both water bodies are located in a deep, steep-walled basin at 1,130 m, Washington. Red D. kenai contain over three times (7.49 micro g/mg dwt) as much pigment as blue D. kenai (2.30 micro g/mg dwt). When exposed to light from blue fluorescent lamps, average time to death for red copepods is 5.68 d compared to 2.47 d for blue copepods. The significance of blue carotenoprotein is nuclear. A blue copepod is less visible to pred-

ators since its color matches the environment more closely than red copepods. A selective compromise between predation pressures and photodamage might be reached by binding carotenoid to proteins and turning it blue. Carotenoid contents for D. sicilis and D. nevadensis adults from two other mountainous Washington lakes was determined for animals collected at different depths. In five out of seven cases, copepods near the lake surface are significantly more pigmented than those collected at greater depths. (Danovich-Wisconsin)
W80-02549

POPULATION DYNAMICS OF EUDIAPTOMUS GRACILIS (SARS) IN LAKE OHRID,
Hidrobioloski Zavod, Ochrida (Yugoslavia).
J. Serafimova-Hadzisce.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2546-2550. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Population, *Copepods, *Lake Ohrid, Yugoslavia, *Life history studies, *Life cycles, Zooplankton, Crustaceans, Biomass, Period of growth, Growth rates, Growth stages, Sexual maturity, Reproduction, Seasonal, Animal behavior, Ecology, Density, Stability.

A comprehensive zooplankton investigation for Lake Ohrid, Yugoslavia, was carried out April 1973-June 1975; yearly demographic structure for Eudiaptomus gracilis was repeated annually showing that not only plankton communities in general but also separate species have great stability in large, deep lakes. E. Gracilis is the most important zooplankton component in Lake Ohrid. In April, E. gracilis has a maximum number of naupliar and copepodite stages as well as large adult numbers. It reaches 4,000 ind/cu m. Intensive reproduction also occurs during this period. In June, copepods dominate but E. gracilis decreases in density to 1100-1800 ind/cu m. During July and August, E. gracilis populations continue to decline. In September, density varies 1300-2400 ind/cu m and copepodites are particularly abundant while other stages have low numbers. November to January, population density decreases. In February, E. gracilis begins to reproduce; March is characterized by intense reproduction. About 90% of females carry eggs and males adult numbers increase. Although E. gracilis occurs throughout the year, it is the dominant copepod species during winter and spring. Laboratory experimental research concludes that E. gracilis turnover time is three times per year. (Danovich-Wisconsin)
W80-02550

CARBON ANALYSIS FOR THE DETERMINATION OF INDIVIDUAL BIOMASSES OF PLANKTONIC ANIMALS,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
R. Latja, and K. Salonen.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2556-2560. 4 Tab, 12 Ref.

Descriptors: *Carbon, *Zooplankton, *Weight, *Analytical techniques, *Testing procedures, Size, Speciation, Seasonal, Volumetric analysis, Testing, Lake Paajarvi, Finland, Lake Ormajarvi, Finland, Evaluation, Specific gravity, Organic matter, Lakes, Oligotrophy, Eutrophication.

Organic carbon analysis as a possible solution to the problem of systematic errors allows determinations in single animals down to 0.01 micro g C in one minute. Zooplankton were collected from mesohumic oligotrophic Lake Paajarvi and eutrophic Lake Ormajarvi, Finland. Each animal is transferred to a high temperature combustion tube (950 C) and carbon dioxide release is measured by infrared gas analysis. Standard deviation for one sample varies 20-60% of the mean. Analysis precision is better than 1% at 1 micro g C level. Measured carbon weights are higher than those calculated from volumes assuming a specific gravity of 1, dry weight 10% of wet weight, and carbon 50% of dry weight. However, Asplanchna priodonta shows calculated values much higher (4-100 times) than measured ones. Rotifer carbon levels are 5-10% wet weight. However, for Asplanchna, the respective level is only 0.8%. Individual carbon weights for Asplanchna reveal considerable seasonal variation. In summer, mean weight is five times higher than in early spring and values for the same season in successive years are similar. Limnoclanus macrurus carbon content is 3.2-3.5 times more in autumn than in spring. Eudiaptomus gracilis carbon weights for similar-sized animals are higher in late winter in Ormajarvi than in more oligotrophic Paajarvi. Dry weight is reliable for individual biomass measurements, but differences between lakes and seasons complicate using general values for a given species' individual weight. (Danovich-Wisconsin)
W80-02551

POPULATION STRUCTURE AND LIFE-CYCLE OF NEOMYSIS INTEGER (LEACH) (CRUSTACEA, MYSIDACEA) IN TWO TYPES OF INLAND WATERS,
Delta Inst. of Hydrobiological Research, Yerseke (Netherlands).
C. H. Borghouts.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2561-2565. 4 Fig, 4 Ref.

Descriptors: *Lake Veere, The Netherlands, *Den Inkel, The Netherlands, *Population, *Opossum shrimp, *Life history studies, *Life cycles, Ecology, Zooplankton, Crustaceans, Chlorine, Size, Fecundity, Seasonal, Density, Biomass, Water quality, Growth stages, Growth rates, Sexual maturity, Brackish water.

During January 1970-June 1972, population structure and life-cycle of Neomysis integer were studied in two inland waters: large (1800 ha) brackish water Lake Veere and small (4.4 ha) Den Inkel, Netherlands. In Lake Veere, chlorinity fluctuates 5.5-12.5 ppt during the year. In Den Inkel, chlorinity is rather constant, 7.5-9 ppt. Population differences in Lake Veere and Den Inkel mainly concern animal length and proportion of juveniles. Maximum N. integer length in Lake Veere is 19 mm and in Den Inkel, 13 mm. Difference in length between the populations is due to slower growth in Den Inkel, probably because of higher population densities. Breeding females of Lake Veere are larger than those in Den Inkel; brood-size in Lake Veere therefore is larger than in Den Inkel. In both waters, breeding females are larger in spring than in autumn. In spring, Lake Veere lengths are 15-19 mm, in Den Inkel, 10-13 mm. In autumn, breeding females lengths are 10-15 mm and 7-9 mm, respectively. Life-cycle of both populations does not differ. The overwintering generation breeds in April-May and produces the spring generation. This spring generation grows, matures, and starts breeding in June-July. This continues until September in Lake Veere and until August in Den Inkel. Animals born in autumn grow up and overwinter. (Danovich-Wisconsin)
W80-02552

POPULATION DYNAMICS AND BIOMASS PRODUCTION OF NEOMYSIS INTEGER (LEACH) IN THE BERGUMERMEER,
Limnological Inst., Oosterzee (Netherlands).
D. M. Beattie, and H. DeKruijf.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2566-2571. 7 Fig, 6 Ref.

Descriptors: *Bergumermeer, The Netherlands, *Biomass, *Population, *Opossum shrimp, *Life history studies, *Electric powerplants, Standing crops, Ecology, Zooplankton, Crustaceans, Life cycles, Juvenile growth stage, Growth stages, Growth rates, Heated water, Thermal stress, Bottom sediments, Density, Seasonal, Discharge(Water), Thermal pollution, Thermal water.

From June 1976-June 1977, Neomysis integer population dynamics were observed in Bergumermeer a shallow eutrophic powerplant, situated in The Netherlands; thermal discharges have negligible effects on N. integer population development. The lake has 4.65 sq km surface area and 1.3 mean depth; western sections have mud or peat, soft substrate bottoms while the eastern part has harder sand substrates. Population growth rates are similar on hard and soft substrates, but population size on hard substrates is three times larger than on soft substrate. Virutally 100% of the population is on the bottom during the day, while it spreads throughout the water column at night. Population development occurs May to September (1/sq m to 4,500/sq m), constituting a continuous breeding season with maximum population density peaks following periods of more intensive breeding. Changes in N. integer standing crop biomass closely parallel changes in population density. An exponential increase in dry weight standing crop biomass occurs July to September (0.1 to 62.0 kg/ha), accompanying juvenile influx into the population. Mean dry weight per individual is 0.91 mg. Standing crop biomass continues to increase until October (154.0 kg/ha) due to increases in mean dry weight per individual to 1.65 mg, although population density is constant. Slower and more erratic population growth occurs near the powerplant outlet due to variable cooling water discharges and increased fish predation. (Danovich-Wisconsin)
W80-02553

INTRASPECIFIC OSMOREGULATORY COMPARISON IN GAMMARUS PULEX (CRUSTACEA: AMPHIPODA),
Amsterdam Univ. (Netherlands). Limnological Lab.
J. Dorgelo.
In: Proceedings: Congress in Denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2573-2578. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Salt tolerance, *Metabolism, *Amphipoda, *Osmosis, *Habitats, Salinity, Saline water, Brackish water, Salts, West Germany, The Netherlands, Resistance, Animal behavior, Environment, Crustaceans, Population, Freshwater, Ecology, Mortality, Desalination processes, Animal physiology.

This study analyzes salt tolerance, salt preference, and blood sodium regulation of Gammarus pulex populations from The Netherlands and West Germany in environments with increasing sodium, chloride and calcium concentrations. Tolerance curves, and to a lesser extent, preferential behavior show differences according to increasing habitat salinity. However, different blood sodium concentrations do not correlate with salinity habitat trends. G. pulex populations survive well at all sampling stations. The population from the most brackish environment has the greatest salt tolerance. Curves for two freshwater populations resemble the curve for G. fossarum, which marks these populations as genuine fresh-water populations. Populations which live under less-saline conditions tend to have a decreasd salt tolerance. Regarding salt preference, the genuine fresh-water species is characterized by a lack of preference; distribution in choice chambers is unstable. Some other populations prefer their habitat water while still others behave indifferently to concentrations within 1 ppt of their habitat water concentration. Regulation sensing matintenace of a more or less constant blood sodium content occurs in low salinities only. G. pulex shows hyperregulation levels that drop with decreasing habitat salinity. Populations from the most limnetic conditions have the highest blood sodium concentration. (Danovich-Wisconsin)
W80-02554

AMPHIPODA FROM SKADAR LAKE AND ITS DRAINAGE SYSTEM,
Biological Inst., Titograd (Yugoslavia).
G. S. Karamna.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2579-2583. 1 Fig, 15 Ref.

Descriptors: *Amphipoda, *Habitats, *Distribution, *Skadar Lake, Yugoslavia, *Drainage area, Crustaceans, Invertebrates, Environment, Ecology, Distribution patterns, Ecological distribution, Speciation, Population, Systematics, Water temperature, Watersheds(Basins), Varieties, Caves, Wells, Rivers, Spring waters.

Amphipoda in the drainage system of Skadar Lake, Yugoslavia consists of one family' (Gammaridae), of seven general with a total of 16 species, namely: Echinogammarus scutarensis, E. veneris, Gammarus balcanicus, G. roeselii f. tricanthus, Hadzia gjorgjevici crispata, Niphargus asper, N. brevicuspis sketi, N. inclinatus, N. maximus vulgaris, N. podgoricensis, N. vranjinae, N. zorae, Metohia carinata, Synurell ambulans, S. intermedia montenigrina, and Typhlogammarus mrzeki. Echinogammarus and Gammarus species inhabit surface waters, 11 species (general Niphargus, Typhlogammarus, Metohia, Hadzia, and species S. intermedia montenigrina) settle only in subterranean waters while S. ambulans lives in surface and subterranean waters. In the lake itself, amphipoda are poorly represented and exist only in coastal areas influenced by springs and rivers (E. veneris, E. scutarensis, G. balanicus, G. roeselii, S. ambulans). This is caused by warm lake temperatures which reach 29 C. Subterranean fauna are abundant with five genera and 12 species. Nine subterranean species are endemic and a single surficial species, E. scutarensis, is endemic. Two species, T. mrazeki and M. carinata, are endemic for west Balkan. Species G. balcanicus, G. roeselii, E. veneris, and S. ambulans are widely distributed. Skadar is a large subtropical lake situated in southeast Yugoslavia with a 4000 sq km drainage system. Median water level varies around 370 sq km; mean depth is 6 m but lake levels vary up to 4 m. (Danovich-Wisconsin)
W80-02555

LIFE HISTORIES OF FOUR SPECIES OF EPHEMEROPTERA,
T. T. Macan.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2594-2598. 1 Fig, 9 Ref.

Descriptors: *Life history studies, *Life cycles, *Lune River, Great Britain, *Mayflies, Reproduction, Growth rates, Growth stages, Water temperature, Ecology, Animal behavior, Diapause, Aquatic insects, Invertebrates, Emergence, Size, Length, Nymphs, Seasonal, Distribution, Population.

Four Ephemeroptera species, Centroptilum pennulatum, Procloeon bifidum, Centroptilum luteolum, and Baetis scambus, were observed in the Lune River, Great Britain, April to October 1973-1975. Most C. pennulatum nymphs emerge at 7 mm. The generation originates from diapause eggs, starts suddenly about May 21, and numbers increase (47-124) in the first five weeks. A few nymphs are large enough to emerge by June 4. By this third week, sizes range 2-8 mm. This spread indicates that eggs of the next generation hatch over a long time period; identification of generations is less likely with each succeeding one. Eggs hatch in one week and a generation takes about five weeks. Quick growers may achieve five generations during a season while slow growers achieve only three. Other life cycles hypothesis suggest that all cohorts develop from eggs laid the year before; some hatch soon and the rest enter diapause depending upon water temperatures. P. bifidum nymphs are ripe when they reach 5-7 mm. Generations are similar to C. pennulatum. C. luteolum nymphs emerge when 6 mm and sometimes 5 mm. A few nymphs, most 2 mm, are found throughout winter. During summer, there are probably four or five generations. B. scambus nymphs emerge when 5 mm, although some are only 4 mm. Their numbers are larger than any other species and tend to be separated by very low numbers. Low catches suggest a long period in the egg. Generations take a month and the season lasts longer for B. scambus than any other species. (Danovich-Wisconsin)
W80-02556

PRODUCTION OF TWO SPECIES OF EPHEMEROPTERA (EPHEMERELLA IGNITA PODA AND RHITHROGENA SEMICOLORATA CURTIS) IN THE UPPER REACHES OF THE R. WYE, WALES,
Llysdinam Field Centre (Wales).
M. P. Brooker, and D. L. Morris.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2600-2604. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Mayflies, *River Wye, Wales, *Habitats, *Primary productivity, Aquatic insects, Invertebrates, Productivity, Density, Distribution, Ecology, Population, Growth rates, Turnovers, Biomass, Analytical techniques, Estimating, Depth, Emergence, Life cycles.

Two sites in headwaters of the Wye River, Wales, were intensively studied March 1975-April 1976 for production estimates of two Ephemeroptera species; annual production of Ephemerella ignita and Rhithrogena semicolorata is 89 and 353 mg dwt/sq m. Both study sites are typical salmon nursery areas with cobbles and coarse gravel forming a riffle habitat. E. ignita and R. semicolorata form a substantial proportion of total invertebrate and ephemeropteran density. R. semicolorata reached 470/sq m mean peak density (November) and E. ignita reached 440/sq m in June. Over 90% of each species occurs within 10 cm of the water surface, the rest within 20 cm. Differences in production occur between sites for both species; however, calculation method differences are significant. One method excludes negative production (A) and the other includes average instantaneous growth rates (B). For E. ignita at the most distant headwater site, method A estimates production at 344 mg dwt/sq m; method B, 794 mg dwt/sq m. Production for R. semicolorata is 216 (A) and 249 (B) mg dwt/sq m. At the other site, E. ignita production values are 89 (A) and 164 (B) mg dwt/sq m, while for R. semicolorata values are 353 (A) and 435 (B) mg dwt/sq m. (Danovich-Wisconsin)
W80-02557

PRELIMINARY NOTES ON THE EFFECT OF TEMPERATURE AND LIGHT-CONDITION ON THE TIME OF HATCHING IN SOME HEPTAGENIIDAE (EPHEMEROPTERA),
Oesterreichische Akademie der Wissenschaften, Vienna. Limnologisches Inst.
U. Humpesch.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2605-2611, 3 Fig, 14 Ref.

Descriptors: *Water temperature, *Amphipoda, *Hatching, *Seebach River, Austria, *Period of growth, *Light, *Animal physiology, Growth rates, Growth stages, Broods, Clutch, Invertebrates, Diurnal, Timing, Laboratory tests, Larvae, Embryonic growth stage, Insect eggs, Aquatic insects.

Processes of and times required for embryonic development of Ecdyonurus picteti from Seebach River, Austria, were studied under varying light and temperature conditions. Embryonic development is dependent on temperature but not on light. Larvae hatch from eggs which have been laid in one water body in different seasons, at different times. With increasing temperatures, development time decreases. E. picteti was studied in temperatures ranging 6-20 C; the Belehradek Function best fits all results. In constant temperatures, larvae hatch after 50-52 days at 8.4 C. Since eggs in Seebach are exposed to fluctuating temperatures, the influence of diurnal temperature changes on embryonic development time was also examined. In the Seebach with temperature variations 6.2-10.2 C (average 8.2 C), eggs begin to hatch after 47 days. However, under laboratory conditions of temperature variations 5.7-10.9 C (average 8.4 C), the first larvae hatched after 45 days. Special physiological mechanisms accelerate development time under changing temperature conditions and exceed a simple summation of temperature effects. The number of eggs produced by a female varies 1200-7500. Hatching success under constant and fluctuating temperatures per female is 25%. Unfertilized eggs develop at all temperatures tested: development times are one-third longer and those for hatching up to five times as long. Hatching rate per clutch varies 0.1-1.0%. (Danovich-Wisconsin)
W80-02558

INFLUENCE OF THE WATER MITE HYDRACHNA CONJECTA ON THE POPULATION OF THE CORIXID SIGARA STRIATA (HEMIPTERA),
Amsterdam Univ. (Netherlands). Zoological Lab.
C. Davids, M. E. Al, and J. Blaauw.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2613-2616, 3 Fig, 2 Ref.

Descriptors: *Mites, *Water beetles, *Population, *Food habits, *Productivity, *Parasitism, *Laboratory experiments, *Insect behavior, Aquatic insects, Nymphs, Foods, Food abundance, Insect eggs, Broods, Feeding rates, Water temperature, Invertebrates, Fecundity.

Hydrachna conjecta, a water mite whose nymphs and adults feed on water bugs' eggs and whose larvae are parasites of adult water bugs, takes away about 25-35% of corixid Sigara striata egg production. These figures assume a 10% infestation rate. H. conjecta egg consumption averages 191 and 220 eggs/mite when mites are fed 9 and 12 eggs/d, respectively. Average S. striata egg consumption is 4.5 eggs/d in the laboratory; in nature, consumption is probably higher. When nymphs do not receive any food, they do not enter the resting stage between nymph and adult. Several nymphs also perished when fed 1 egg/d. S. striata egg production increases with increasing temperature. Under experimental conditions, mean egg consumption production is 140 eggs/female; at 16-20 C, they produce 16 eggs/wk; in nature egg production might be higher. Infestation rates are also considered, since infested water bugs do not produce eggs. A basic estimate of 10% is chosen although infestation rates in nature are often higher. Mites, therefore, greatly influence water bug populations by consuming up to 35% of their eggs. (Danovich-Wisconsin)
W80-02559

LIFE HISTORY AND DYNAMICS OF A HYDROPSYCHE INSTABILIS CURTIS (TRICHOPTERA, HYDROPSYCHIDAE) POPULATION IN A WEST GERMAN WOODLAND BROOK,
Bonn Univ. (Germany, F.R.). Inst. fuer Landwirtschaftliche Zoologie und Bienenkunde.
N. Caspers.
In: Proceedings: Congress in Denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2617-2621, 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Katzenlochbach, West Germany, *Phenology, *Life history studies, *Standing crops, *Caddisflies, Population, Seasonal, Ecology, Growth rates, Invertebrates, Biomass, Life cycles, Biorhythms, Productivity, Insect eggs, Hatching, Insect behavior, Turnovers, Aquatic insects.

Phenology, growth pattern, and standing crop of Hydropsyche instabilis (creek-dwelling caddis fly) populations were investigated in Katzenlochbach, a West German woodland brook, January 1976-July 1977. Both Allen curve and instantaneous growth methods yield similar production values of 3.07 and 3.01 g/sq m yr, respectively. Annual turnover ratio, defined as annual production divided by mean annual standing crop, is 3.4. The semivoltine part of the H. instabilis population contributes about one-third of the production rate values. Production rates are compared with those for other creek-dwelling invertebrates. Production rates of predacious species (leeches) are distinctly lower than in H. instabilis, whereas small herbivorous species (Ephemerella subvaria) show the highest production rates. H. instabilis imagines emerges and oviposits in late June and all July. Hatching time lasts from late July to late September. By November most larvae reach third instar

level, the prevailing stage until early spring. From November to February population size drops to 10% of initial size due to high drifting rates. Flight period starts again in late June. Biomass values increase from hatching time throughout autumn months and reaches a 2 g/sq m peak in November. Mean annual biomass of Hydropsyche larvae is 0.91 g/sq m. (Danovich-Wisconsin)
W80-02560

LIFE CYCLE OF LIMNEPHILUS AFFINIS CURT, (TRICHOPTERA: LIMNEPHILIDAE) IN ICELAND AND IN NORTHUMBERLAND, ENGLAND,
Iceland Univ., Reykjavik. Inst. of Biology.
G. M. Gislason.
In: Proceedings: Congress in Denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, p 2622-2629, 1978. 9 Fig, 7 Ref.

Descriptors: *Life history studies, *Life cycles, *Iceland, *Great Britain, *Caddisflies, *Growth states, *Temperature, Population, Seasonal, Ecology, Phenology, Growth rates, Invertebrate, Aquatic insects, Insect eggs, Hatching, Insect behavior, Reproduction, Period of growth, Geographical regions.

Limnephilis affinis life cycles in Great Britain's temperature climate are synchronized, with oviposition in the autumn and emergence in the spring whereas in Iceland's subarctic climate, oviposition takes place from spring, during summer, and into autumn. In Iceland larval growth takes place in summer and autumn and again in spring and early summer, depending upon hatching times. In Icelandic lowlands, flight periods start in March; adults are still found in October. In Icelandic highlands, flight periods extend from June to August. In England, L. affinis flight periods extend from late April to November. Immature females are found in June, mature in August, and maturing and females after oviposition in September. This indicates that L. affinis females in England undergo ovian quiescence during summer, as described for Limnephilis species in Europe. Water temperatures are much lower in Iceland than in England, and therefore, growth rates in Iceland are much slower. L. affinis growth rates are fastest at 20 C, and slow at 2-5 C. L. affinis larvae from Iceland were collected from Straumsvik Bay, 13 km south of Reykjavik; larvae from Britain were collected from salt marsch pools in Seaton Sluice. (Danovich-Wisconsin)
W80-02561

REGIONAL COEXISTENCE OF FOUR CHAOBORUS SPECIES,
Northern Illinois Univ., De Kalb. Dept. of Biological Sciences.
C. N. Von Ende.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2630-2633, 1 Tab, 8 Ref.

Descriptors: *Diptera, *Habitats, *Size, *Predation, *Vertical migration, *Distribution patterns, Michigan, Speciation, Aquatic insects, Invertebrates, Emergence, Environment, Ecology, Niches, Competition, Adaptation.

Size and distribution patterns of four Chaoborus species that occur in lakes in the Upper Peninsula of Michigan are correlated with predation and with interference competition. Chaoborus americanus, C. flavicans, C. punctipennis, and C. trivittatus were observed. All species except C. americanus occur in lakes with fish and all species in lakes with fish undergo diurnal migration; they are in deep layers during the day and rise close to surface waters at night. Mean C. punctipennis length is 9.3 mm; C. flavicans, 10.8 mm; C. americanus, 12.4 mm; and C. trivittatus, 12.8 mm. Species also differ with respect to recruitment timing. C. americanus emerges in mid-May, C. flavicans at the end of May, C. punctipennis at the end of June, and C. trivittatus at the end of August. Because of its small size and vertical migratory behavior, C. punctipennis is well adapted for lakes without fish. Its early emergence is advantageous for a species found in shallow pools by allowing it to get to the more hardy, later instars as quickly as possible. Its larger size is advantageous in fishless habitats which are usually dominated by larger zooplankton species. The other two species are less parochial. C. flavicans' intermediate size allows it to survive in lakes dominated by either large or small zooplankton. C. trivattatus' vertical migration allows it to survive in fish lakes, and its recruitment timing in certain fishless lakes. (Danovich-Wisconsin)
W80-02562

STUDY OF DYNAMICS OF POPULATIONS OF AQUATIC INSECTS: THE PROBLEM OF VARIABILITY IN LIFE HISTORY EXEMPLIFIED BY TIPULA SACRA ALEXANDER (DIPTERA: TIPULIDAE),
Calgary Univ. (Alberta). Dept. of Biology.
G. Pritchard.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, p 2634-2640. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Diptera, *Life history studies, *Canadian Rocky Mountains, *Beavers, *Population dynamics, *On-site tests, Population, Aquatic insects, Invertebrates, Life cycles, Variability, Environment, Environmental effects, Testing, Evaluation, Emergence, Ponds, Larvae.

A simple cohort-splitting hypothesis for Tipula sacra (Diptera) populations is not supported by data under all field testing conditions in beaver ponds in the Canadian Rocky Mountains, October 1973-1977. Most temperate latitude aquatic insect populations experience variable growth rates due to changing environmental conditions; individuals from a single egg cohort may complete their development in different years. In order to clarify cohort identification problems, various algebraic and graphical models have been developed. This hypothesis states that most individuals in populations follow either two-year or one-year cycles; it is consistent with data showing two peaks in the emergence curve and two times of year at which recruitment to instar IV occurs. In October 1973, rearing-emergence cages were set up to test the hypothesis. An unplanned test occurred when beaver, which had been absent from the site for 14 years, recolonized ponds in July 1974. The hypothesis is too deterministic in its approach to larval growth predicting greater synchronization than clearly exists. T. sacra populations live in habitats subject to irregular changes and such variability clearly has adaptive consequence. However, life budget productions cannot be achieved even if precise cohort-splitting information if available, unless proportions in various cohorts are determined at all life cycle stages. (Danovich-Wisconsin)
W80-02563

PHENOLOGY OF CHIRONOMUS SPP. IN SALINE LAKES OF CENTRAL BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Zoology.
R. A. Cannings, and G. G. E. Scudder.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2641-2646, 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Emergence, *Diptera, *British Columbia, *Phenology, *Saline lakes, Aquatic insects, Speciation, Mature growth stages, Growth stages, Animal behavior, Insect behavior, Psychological aspects, Ecology, Life cycles, Biorhythms.

Phenology of three Chironomus species at the 1 m depth is compared for seven central British Columbia lakes, May-August 1970, and contrasted with Einfeldia pagana and Glyptotendipes barbipes. When two or more Chironomus species coexist, a very restricted emergence occurs, suggesting some interspecific interactions between species. Chironomus emergence periods, even though very short, are quite different in most lakes. The same species emerges at different times in different lakes. Also, only rarely do two coexisting Chironomus species emerge at the same time. E. pagana and G. barbipes adult emergence occurs May to August. Divergence of emergence patterns in Chironomus species is not seen in E. pagana and G. barbipes emergence patterns; these two species have similar ecologies to Chironomus species and are herbivorous. Lakes occur at the same elevation (1,000 m), and have the similar mean and maximum depths; however, they differ greatly in salinity and ionic composition, ranging 488-11,816 micro mhos in mean conductivity. (Danovich-Wisconsin)
W80-02564

SEASONAL AND BETWEEN YEAR VARIATION IN THE CHIRONOMID LARVAE OF A CHALK STREAM,
Reading Univ. (England). Dept. of Zoology.
J. F. Wright.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2647-2651, 2 Fig, 5 Ref.

Descriptors: *Habitats, *Diptera, *Larval growth stage, *Seasonal, *Annual succession, Larvae, Growth stages, Streams, Great Britain, Substrates, Streambeds, Streamflow, Population, Flow, Density, Macrophytes, Colonization, Low flow.

Chironomid larvae were observed in a chalk stream habitat in southern England, 1971-1976; despite differences in larval density on five stream habitats, between-year variations are of a more substantial nature. Stream habitats include: gravel, detritus, and three macrophytes, Ranunculus, Berula, and Callitriche. Ranunculus is the dominant macrophyte, covering 16.8%-51.6% of the area. Gravel covers 36.5%-53.8%. Macrophytes support higher chironomid densities than other substrates. Greatest between-month stability occurs on Ranunculus. In early spring, Ranunculus is minimal and shows little between-year variation. High discharge between March and May encourages rapid Ranunculus colonization, whereas limited colonization is associated with low discharge. The lowest spring flow occurred in 1976 and by June Ranunculus covered only 35.9% of the stream bed and chironomid densities on this substrate numbered 3,200/0.5 sq m. In contrast, Ranunculus colonized 66.5% of the stream bed in June 1975, following the highest spring discharge; chironomid densities on Ranunculus numbered only 8000/0.05 sq m. Although the percentage of stream bed covered by Ranunculus in early June varies by a factor of two, habitat quality rather than quantity is of greater significance, since between-year variation in chironomid larvae density may differ by more than one order of magnitude. In low discharge years, algae and associated detritus which hold back Ranunculus spring growth, enable high chironomid population densities. (Danovich-Wisconsin)
W80-02565

A CONSOLIDATION MODEL OF SEDIMENTS (LAKE),
Tokyo Univ. of Fisheries (Japan).
S. Kanari.
In: Proceedings; Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2658-2662, 3 Fig, 1 Tab.

Descriptors: *Mathematical models, *Lake Biwa, Japan, *Deposition(Sediments), *Sedimentation, *Consolidation, *Paleohydrology, Equations, Model studies, Curves, Compressibility, Lake Sediments, Sedimentation rates, Stratigraphy, Sediment load, Settling velocity, Diagenesis, Density, Compaction.

Use of a mathematical model for consolidating lake sediments shows that in-situ sedimentation rates in Lake Biwa, Japan in the past 170,000-180,000 years would have been five times as large as present rates. In-situ sedimentation rates at the present bottom surface in Lake Biwa are estimated at 0.2 cm/yr. Ages of nine layers of a Lake Biwa sediment core were determined by carbon-isotopic and fission-track methods. The constant compression

model focuses on consolidation processes at the real lake bottom which differ slightly from Darcy's pore water flow velocity. Succeeding sediment accumulations bring an increasing flow path as well as an increasing pressure gradient in underlying sediments, which cause slight differences in pore water flow. In the model, pore compressiblity at any depth is assumed constant and Lake Biwa core measurements are used to determine equation parameters. Since the true age at every depth is known, in-situ sedimentation rate changes in the past lake bottoms were calculated. (Danovich-Wisconsin)
W80-02567

POLLEN ANALYSIS OF A 200-M CORE SAMPLE FROM LAKE BIWA,
Kanazawa Univ. (Japan). Dept. of Earth Sciences.
N. Fuji.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2663-2665, 2 Fig, 3 Ref.

Descriptors: *Sediments, *Palynology, *Lake Biwa, Japan, *Climatic zones, Geology, Dating, History, Pollen, Spores, Temperature, Vegetation, Plant groupings, Cold regions, Temperate, Climatology.

Existence of six pollen zones ranging from cold to warm climatic stages was established by examining core samples taken from Lake Biwa, Japan. During cold stages, typical vegetation in summit areas near Lake Biwa consist of subalpine plants. In lowland areas, cool temperate plants are present. In warm stages, vegetation in high areas is characterized by plants of the cool temperate and present temperate zone. Lowland vegetation consists of broadleaved deciduous and evergreen trees growing in the warm temperate zone. During the last cold stage, about 17,000 years ago, mean annual temperatures were 7-8 C. The height of the snow-line during that last cold stage was 2,600 m above present sea-level compared to the present snow-line at 4,300 m. Human influence represented by clearing forests and rice-cultivation began 3,000 B.P. Pollen interpretation of the 200 m core and vegetation reconstruction during the last 600,000 years was done by two methods; pollen spectra from modern samples around Lake Biwa and neighboring Japanese Islands, and the warmth index. (Danovich-Wisconsin)
W80-02568

STABLE CARBON ISOTOPE STUDY OF A 200-M CORE SAMPLE FROM LAKE BIWA,
Nagoya Univ. (Japan). Dept. of Earth Sciences.
N. Nakai.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2666-2669, 2 Fig, 8 Ref.

Descriptors: *Lake Biwa, Japan, *Sediments, *Carbon, *Isotope studies, *Palynology, Climatic zones, Cold regions, Temperate, Climatology, Geology, Dating, History, Temperature, Deposition (sediments), Diatoms, Bioindicators, Organic matter, Stable isotopes.

Stable carbon isotopic compositions and organic carbon contents correlate with fossil diatom cell numbers and with palynological climate in a study of a 200 m core sample from Lake Biwa, Japan. Results also show that stable carbon isotope measurements of sedimentary organic materials are sensitive indicators of past climatic changes. Carbon in organic materials has isotopic values ranging -31.8% to -37.9%; total organic carbon contents range 0.3%-1.2%. Value change widely with depth. Smaller carbon isotope values of plankton and sedimentary organic materials tend to occur when climates are colder. Vertical fluctuations in fossil diatoms cell numbers throughout the entire core column are similar to those of organic carbon contents and carbon isotope values. Abundant periods of diatom cells, which are warm or temperate climate, correlate well with high organic carbon and large carbon isotope periods. Therefore, organic carbon amounts in sediments represent production activities when the sediments were deposited. Palynological paleoclimate correlates well with carbon isotope fluctuations. In a warm or temperate climate, organic material production and accumulation rates in bottom sediments are relatively high, resulting in relatively higher carbon isotope enrichment than in cold climatic periods. Ten temperate and 12 cold periods occurred during the last 565,000 years based on the Lake Biwa core column. (Danovich-Wisconsin)
W80-02569

ORGANIC GEOCHEMISTRY-BIOCHEMICAL ORGANIC MATTER,
Nagoya Univ. (Japan). Water Research Inst.
N. Handa.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2671-2673, 1 Fig, 9 Ref.

Descriptors: *Chlorophyll, *Biochemistry, *Organic matter, *Lake Biwa, Japan, *Geochemistry, Carbon, Pigments, Phytoplankton, Population, Geology, History, Sediments, Diatoms, Algae, Plant pigments, Organic loading, Sedimentology.

Chlorophyll derivatives and carotenoids were determined in a 200 m core sample taken from Lake Biwa, Japan; pigment concentration vertical fluctuations coincide with those of ratio values of the sum of carbohydrate, protein, and amino acids and lipid materials carbons (CPL) to total sedimentary organic carbon. Data indicate that lake phytoplankton population abundance has varied in the last 500,000 years. Chlorophyll derivatives in the core sample range 22-374 units/g dry sediment. Allochthonous contribution is minimal while autochthonous phytoplankton is the sole source of sedimentary chlorophyll derivatives. Correlation coefficient for chlorophyll derivatives concentration and the CPL: total organic carbon ratio is 0.88. Relatively high fossil diatoms numbers occur at depths where high values of chlorophyll derivatives and CPL/total organic carbon are found. Diatoms populations are one of the main organic matter producers in Lake Biwa. Algal populations other than diatoms may also have an important role in the lake's organic production. (Danovich-Wisconsin)
W80-02570

SOME BIOLOGICAL PROBLEMS,
Kyoto Univ. (Japan). Dept. of Zoology.
H. Kawanabe.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2674-2677, 1 Fig, 17 Ref.

Descriptors: *Speciation, *Sediments, *Lake Biwa, Japan, *History, *Paleohydrology, Geology, Dating, Cold regions, Temperate, Temperture, Productivity, Deposition(Sediments), Varieties, Phylogeny, Ecology, Environmental effects, Environment, Freshwater, Marine biology, Diatoms,.

This paper discusses dendemism and differentiation of several animal and plant species, based on microfossil data of a core sample taken from Lake Biwa, Japan. Endemic organisms include differentiated in-situ, and relic species. Some fish and crustaceans belong in the differentiated in-situ category, including Cnathopegen caerulescens and Carassius cuvieri (Cyprinidae), Chaenogobius isaza (Gobiidae), and Daphnia biwaensis (Daphniidae). Relic lake species include freshwater, warm water organisms (Opsariichthys uncirostris uncirostris): freshwater cold water organisms (Valvata biwaensis); marine warm water organisms (Corbicula sandai): and marine cold water organisms (Kamaka biwae). Melosira juergensi, a marine brackish-water diatom species, is found in several parts of the core, suggesting that the lake was brackish during several interglacial ages. All Stephanodiscus diatoms abruptly change at 110 m in depth. S. carconensis and S. pusilla are found only above 110 m, whereas S. astea and S. minutula are found only below 110 m. Just at 110 m, a large volcanic ash layer 100 mm in thickness occurs. Ash-sorting indicates that eruption occurred during a rather short time; environmental factors changed greatly and most orgamisms were probably on the verge of extinction. At 90 and 100 m depth layers, cell diatom and green algae numbers are very small. On the contrary, production rate is high due to large amounts of chlorophyll derivatives, suggesting shallow lake conditions and submerged plant dominance. (Danovich-Wisconsin)
W80-02571

SEASONAL CYCLES IN THE PHYTOPLANKTON PHOSPHORUS STATUS OF A NORTH TEMPERATE ZONE LAKE (LAKE MEMPHREMAGOG, QUE-VT), PLUS A COMPARISON OF TECHNIQUES,
Mcgill Univ., Montreal (Quebec). Dept. of Biology.
J. L. Sproule, and J. Kalff.
In: Proceedings; Congress in denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2681-2688, 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Phosphorus, *Phytoplankton, *Analytical techniques, *Lake Memphremagog, Quebec, Canada, Phosphates, Nutrients, Limiting factors, Lakes, Kinetics, Nutrient requirements, Seasonal, Temperate, Cycling nutrients, Algae, Water quality, Phosphorus compounds, Deficient elements, Essential nutrients.

Four techniques for measuring algal phosphorus (P) status were compared and used to investigate seasonal P deficiency patterns in Lake Memphremagog, a 40 km long, narrow glacial lake located on the Quebec (Canada)-Vermont (US) border, August 1973-October 1975. The four techniques are: alkaline phosphatase activity (APA), phosphate uptake rate, saturated rate of phosphate uptake (V-max), and boiling water extractable phosphorus (surplus P). Although any of the first three methods combined with surplus P data describe phytoplankton P status, APA makes radioactive isotopes unnecessary and is quick, simple and low cost. The lake exhibits an axial gradient in P deficiency in lake summer and early fall, with greatest and smallest deficiency in north and south lakes sections, respectively; the gradient closely couples the total P concentration gradient. APA, phosphate uptake rates and V-max follow similar seasonal trends, despite changes in phytoplankton composition. While the winter community exhibits no P limitation the community is normally characterized by high APA, phosphate uptake rates and V-max. These measures decline most significantly in P-rich southern lake areas during late summer, indicating an increased P supply, which is also reflected by increased biomass (chlorophyll-a). Surplus P was detected only during the fall, when biomass declined, and in spring. Average lake APA was 53% greater during late summer and fall 1974, than during the same period in 1975. (Danovich-Wisconsin)
W80-02572

INTERDEPRESSION DIFFERENCES IN THE HYPOLIMNETIC AREAL RELATIVE OXYGEN DEFICITS OF DOUGLAS LAKE, MICHIGAN,
Baylor Univ., Waco, Tx. Dept. of Biology.
O. T. Lind.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2689-2696, 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Douglas Lake(MI), *Eutrophication, *Oxygen, *Hypolimnion, *Land use, Organic matter, Environmental effects, Dissolved oxygen, Oxygen demand, Oxygen requirements, Regression analysis, Degradation(Decomposition), Carbon, Primary productivity, Lakes, Depth, Bathymetry, Water properties, Land development, Recreation.

Hypolimnetic oxygen deficits among depressions in Douglas Lake, Michigan, June-July 1971, do not support a hypothesis of greater allochthonous and autochthonous organic loading at the west end of the lake near Fairy Island depression where land development is concentrated. However, three

kinds of analysis suggest that eutrophication is accelerated relative to lake and lake shore use: comparisons of hypolimnetic areal relative oxygen deficiets among lake depressions; comparison of South Fishtail Bay oxygen deficit data with that of previous years; and comparisons with primary production data. Three major depressions in Douglas Lake were observed; Fairy Island depression (FID), Grapevine Point depression (GPD), and South Fishtail Bay degression (SFBD) which are located in western, central and eastern lake sections, respectively. Mean dissolved oxygen concentrations in hypolimnion layers vary from 4.07 (FID), 4.25 (GPD), and 3.29 mg/l (SFBD) on June 24 to 0.33 (FID), 0.17 (GPD), and 0.20 mg/l (SFBD) on July 29. Oxygen loss rate is only 0.062 mg oxygen/sq cm d (GPD) compared to 0.097 (FID) and 0.102 mg/sq cm d (SBFD). Less oxygen demand in mid-lake GPD than either of the other depressions. Total organic Carbon content is initially much greater in both FID and SFBD than GPD; however, a linear decline occurs in SFBD so that the final SFBD content is similar to that of GPD. (Danovich-Wisconsin)
W80-02573

EFFECT OF A PUMP-STORAGE HYDROELECTRIC SCHEME ON THE STRATIFICATION AND ECOLOGY OF A SCOTTISH LOCH,
Glasglow Univ. (Scotland). Dept. of Zoology.
R. Trippett.
In: Proceedings, Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2697-2700, 3 Fig, 2 Ref.

Descriptors: *Loch Awe, Scotland, *Pumped storage, *Environmental effects, *Ecology, *Thermal stratification, *Electric powerplants, Entrainment, Reservoir operation, Plankton, Phytoplankton, Zooplankton, Population, Biological communities, Primary productivity, Productivity, Electric power, Stratification, Pumping, Succession, Speciation, Shannon-Wiener Diversity Index.

Results of 1975-1976 studies of affects of the Cruachan Pump-Storage powerplant on limnology of Loch Awe, North Scotland show that productivity is reduced in the plant vicinity; effects include lower plankton populations, peak populations, and zooplankton diversity, and deepened thermocline. Loch Awe is 24 sq km; north and south basins are 75 and 94 m deep, respectively. The power station was built on the north basin in 1968. At the beginning of stratification, effects of mixing from the pumped storage deepen the thermocline from 8 to 12 m and make the metalimnion sharper. In the south basin, phytoplankton grow rapidly in mid-May. Zooplankton growth shows three peaks throughout the summer and a succession of organisms from copepods (April-May) to rotifers and Cladocera (June-August). The Shannon-Weiner Index of community diversity shows that phytoplankton diversity fell rapidly in spring but steadily increased throughout the summer to 3.5 in October. Zooplankton community diversity in the south basin is slightly higher in late spring and summer (2.8) than in October (1.8). In the north basin, phytoplankton experienced a smaller peak population which also took longer to develop. Increased water circulation, instituted by the power station, increases the epilimnion layer which means that populations are dispersed through a greater water depth. Zooplankton diversity is consistently lower, indicating that zooplankton either avoid the power station or passage through turbines is detrimental to populations. (Danovich-Wisconsin)
W80-02574

EFFECTS OF SEWAGE DIVERSION IN LAKE SODRA BERGUNDASJON. II. PHYTOPLANKTON CHANGES AND THE ROLE OF NITROGEN FIXATION,
Lund Univ. (Sweden). Limnological Inst.
L. Leonardson, and L. Bengtsson.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2701-2707, 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Nitrogen fixation, *Phosphorus, *Cyanophyta, *Sewage diversion, Lake Sodra Bergundasjon, Sweden, Sweden, Nitrogen, Cycling nutrients, Nutrients, Phosphates, Microcystis, Anabaena, Aphanizomenon, Waste water treatment, Pollution abatement, Eutrophication, Lake renewal, Lakes, Phytoplankton.

Nitrogen fixation is shown to maintain phytoplankton blooms after sewage diversion. Lake Sodra Bergundasjon, Sweden received wastewater from the city of Vaxjo from 1927 to 1974, after which almost all sewage effluent was diverted from the lake to eliminate the serious pollution effects. The reduced input of nutrients after sewage diversion resulted in decreased mean annual concentrations of total N and total P, but phosphate concentrations remained high due to sediments release. After 1974, combined inorganic N became growth limiting during the summers and there was a drastic change from an almost total dominance of Microcystis to N2 fixing species of Anabaena and Aphanizomenon. N2 Fixation went from 0% in 1974 to 51% and 82% of total N input during the growing seasons in 1975 and 1976 respectively. This N2 fixation together with the high phosphate and phosphorus concentration resulted in a high biomass of blue-green algae after the sewage diversion. As long as there is an excess of available P and other nutrients, it is of no use to build advanced treatment plants for N removal. In the short run, the diversion of sewage effluents is not sufficient to avoid plankton blooms unless the release of P from the sediment can be repressed or the water renewal time is very short. (Luedtke-Wisconsin)
W80-02575

THEORETICAL CONSIDERATIONS ON EUTROPHICATION,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
M. Straskraba.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2714-2720, 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Theoretical analysis, *Graphical analysis, *Eutrophication, IBP-PF analysis, Curves, Nutrients, Phytoplankton, Temperature, Light, Model studies, Photosynthesis, Phosphorus, Limiting nutrients, Latitudinal studies, Chlorophyll-a.

The asymptotic relationship of phytoplankton and phosphorus is re-analyzed using published empirical data, and extends the IBP-PF analysis. Phytoplankton and P are quantified as concentration (chlorophyll-a, total phosphorus, orthophosphate) or by primary productivity and load. Theoretical reconstruction of primary productivity variations along the geographical latitude axis is accomplished by plotting the theoretically obtained annual integral of photosynthetic capacity against latitude. Examination of these examples suggests that productivity in a water body is realized within space of at least five major complex axes: nutrients, geography, morphometry and optical qualities of water, hydrology, and biological interactions of populations. To analyze this complex productivity problem, a multiple-resources kinetics model is proposed emboding the following components: (1) resources most markedly affecting phytoplankton photosynthesis are light, limiting nutrient, temperature, and biomass of the phytoplankton populations; (2) functional responses to the resources named are mutually interrelated; and (3) parameters of the existing functional response-kinetic single resource models are analytical functions of other resources. The multiple-resources kinetics model is graphically illustrated with a multidimensional representation by means of two three-dimensional spaces, the second of which must be inserted into the first. On the basis of this model it is postulated that observed changes in light intensity have nothing in common with light adaption, but are an artifact due to inadequate photosynthetic models. (Luedtke-Wisconsin)
W80-02576

PHOSPHORUS UPTAKE RATES IN PLANKTONIC COMMUNITIES RELATED TO LIGHT GRADIENT,
Quebec Univ., Montreal. Dept. of Biology.
D. Planas.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 2, Part 4, 1978. p 2731-2736, 6 Fig, 13 Ref.

Descriptors: *Phosphorus uptake, *Algae, *Bacteria, *Light intensity, *Absorption, *Phosphorus, Lakes, Hypolimnion, Epilimnion, Lake 302(Canada), Southern Indian Lake(Canada), Canada, Cycling nutrients, Light.

The relative importance of algae and bacteria in lake dynamics are assessed by means of a hypothesis which states that if cells are light-stimulated, phosphorus demand will decrease when cells are in darkness. Two Canadian lakes were studied: Southern Indian Lake, a shallow, unstratified lake, and Lake 302 in the Experimental Lakes Area, a small, summer stratifed lake in which the vertical plankton distribution in the hypolimnion shows an algal peak and a bacteria peak. Sampling was done in three layers: the epilimnion which is very phosphorus deficient; the hypolimnion region with dominant algae; and the hypolimnetic bacterial region. Results indicate that the P uptake does not follow the Michaelis-Menton equation when measured in a wide range of light intensities. Two peaks always occur, one at low light intensities or in the dark, and one at a high intensity. The curve shape of P uptake plotted against light gradient for the hypolimnion samples of Lake 302 is different from those of the Southern Indian Lake samples, but follows the same pattern. The plot of 1/I versus 1/V gives two slope figures; positive for the higher light intensity and negative for the lower. The presence of two peaks or slopes in these plots suggest a phenomenon associated with two different populations which could be related to autotroph and heterotroph organism. The two maxima show some relation with the light measured in the biotope at the moment of sampling and occurred between the 5% to 20% of the surfaces irradiance in the higher and under 0.5% of the peak in the lower. (Luedtke-Wisconsin)
W80-02578

ABSENCE OF PRIMARY PRODUCTION IN SHALLOW OLIGOTROPHIC POND,
North-Eastern Hill Univ., Shillong (India). School of Life Sciences.
J. R. B. Alfred, and N. T. Chellappa.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978. p 2737-2742, 1 Fig, 2 Tab, 26 Ref.

Descriptors: *Primary productivity, *Cycling nutrients, *Diurnal, Phytoplankton, Zooplankton, Nutrient uptake, Eutrophication, India, Bioassay, Oligotrophy, Shillong(India).

Relationships between nutrients and phytoplankton and between phytoplankton and zooplankton are explored during a diurnal period where sunrise to sunset was approximately 12 hours, in contrast to most bioassay and nutrient enrichment experiments which are done seasonally or for short periods of incubation. The experiments were conducted in a shallow oligotrophic pond in Shillong, India. It was hypothesized that as nutrients were added, phytoplankton biomass and zooplankton would increase proportionally. However, results indicate no primary productivity or diurnal rhythm. Respiration was more or less constant for all concentrations of all nutrients. In the enrichment studies, there was an immediate uptake of all concentrations of nutrients which continued at the same level throughout the diurnal period. It is suggested that though a nutrient supply is essential for primary production, the relationship often is not obvious. High assimilation rates coincide with low contents of ammonia, silicate, and nitrogen, which may simply be due to the exhaustion nutrients because of their rapid consumption by the algae. A possible explanation is that enclosed algae could be shut off from any nutrient regenration and therefore create a nutrient limitation not existing in the natural system. (Luedtke-Wisconsin)
W80-02579

REMOVAL OF OIL FROM AN OIL IN WATER EMULSION,
Imperial Chemical Industries Ltd., London (England). (Assignee).
D. B. Chambers.
U.S. Patent No 4,168,229, 4 p, 20 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 661-662, September 18, 1979.

Descriptors: *Patents, *Water pollution treatment, *Oil pollution, *Separation techniques, Zeta potential, Coagulation, Water quality control, Metal fibers.

A method for the removal of oil from an oil in water emulsion comprises contracting the emulsion with a fibrous structure comprising inorganic fibres which, in the emulsion, have a positive zeta potential, and removing the coalesced oil droplets so formed. It is though that the oil droplets being negatively charged, are attracted to the surface of the individual inorganic fibres in the fibrous structure and coalesce forming larger droplets which detach themselves from the fibrous structure. The larger droplets so formed can then conveniently be separated by allowing the droplets to float to the surface to form a layer of oil which can be removed. (Sinha - OEIS)
W80-02615

ENVIRONMENTAL POLLUTION FROM HIGHWAY DEICING COMPOUNDS,
Maine Univ. at Orono.
F. E. Hutchinson.
Journal of the New England Water Works Association, Vol 93, No 2 p 127-135, June, 1979. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Deicers, *Sodium chloride, *Highways, *Environmental effects, Soil contamination, Water pollution, Vegetation effects, Water wells, Ponds, River, New England.

Between 15 and 25 tons per mile of salt are supplied to highways in northern states each winter. This resuts in sodium contamination of soils that threatens vegetation and soil drainage, and chloride contamination of wells and ponds, but has no measureable effect on rivers. At the present time there are no acceptable alternatives to sodium chloride for deicing highways. However, the following steps can be taken to minimize further damage to the roadside environment: (1) Avoid drilling wells too close to highways; (2) Reduce salt use through metering; (3) Select salt-tolerant vegetation for planting along highways; and (4) Exchange sodium ions in soil with calcium ions by applying lime along highways. (Purdin-NWWA)
W80-02657

DISPERSION MODELING IN TIME AND TWO DIMENSIONS,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W80-02664

DYNAMICS OF DISSOLVED OXYGEN IN A HYPEREUTROPHIC LAKE: LAKE KASUMIGAURA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W80-02684

5D. Waste Treatment Processes

ADSORPTION OF FREE AND COMPLEXED METALS FROM SOLUTION BY ACTIVATED CARBON,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
A. J. Rubin, and D. L. Mercer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127244, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center, Ohio State University, Report, August 1979. 68 p, 12 Fig, 7 Tab, 51 Ref. OWRT A-044-OHIO(1).

Descriptors: *Waste treatment, *Water treatment, *Activated carbon, *Adsorption, *Metals, Cadmium, Zinc, Lead.

Investigated was the effect of two complexing agents of different solubilities on the adsorption of cadmium(II), zinc(II) and lead(II) by activated carbon. Studies were run to compare carbons of different isoelectric points, particle size and dosage. The Freundlich and Langmuir isotherms were compared as were curve fitting techniques for evaluating the adsorption parameters. Uncomplexed metals were only slightly removed, the extent of which depended on solution pH and the pK1 of the metal. At very low surface coverage, as with an excess of adsorbent, EDTA appears to enhance the sorption of cadmium. Under more realistic conditions, that is, at high surface coverages, the effect of this soluble chelating agent is to suppress adsorption of metal ion. Therefore, it was concluded that the use of EDTA is detrimental to metals removal. It can be further concluded that complexation with relatively insoluble chelating agents such 1,10-phenanthroline can significantly promote metals removal by activated carbon. There are several limitations to the Langmuir model for representing equilibrium adsorption data, however, the Freundlich equation is even less successful. The chief utility of the Langmuir isotherm is in the use of its parameters Xm and K for the comparison of adsorbents and adsorbates.
W80-02406

POLIOVIRUS TYPE I REMOVAL BY MONTMORILLONITE CLAY,
California Univ., Los Angeles. Dept. of Chemical, Nuclear and Thermal Engineering.
For primary bibliographic entry see Field 5B.
W80-02408

TREATMENT OF EFFLUENTS,
Matthey Rustenburg Refiners (Pty) Ltd., Johannesburg (South Africa). (Assignee).
J. J. MacGregor.
U.S. Patent No 4,162,950, 3 p, 6 Ref; Official Gazette of the United States Patent Office, Vol 984, No 5, p 1189, July 31, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Metals, Separation techniques, Hydrogen ion concentration, Temperature, Electrolysis, Chemical precipitation, Product recovery, Platinum group metals.

Certain very stable and soluble compounds of metals are sometimes encountered which resist all normal chemical and elctrochemical attempts to remove them from solution. In the case of platinum group metals, the high intrinsic value makes such small trace quantities worth recovering. In other cases recovery may be required to prevent infringement of effluent discharge limits. The process for recovering platinum group metal present as a stable complex dissolved in an aqueous effluent from a platinum group metals refinery comprises (1) adjusting the pH of the effluent to an alkalinitz of at least 10; (2) heating to above 60C; (3) electrolyzing the effluent using an anode potential having a half-cell voltage of at least 7.5 volts and current density of at least 0.2 A/sq cm so as to break down the complex by anodic oxidation and precipitate metal present in the complex; and (4) filtering off the precipitated metal. (Sinha-OEIS)
W80-02447

METHOD FOR TREATING PLANT EFFLUENT,
Entenmann's, Inc., Bay Shore, NY. (Assignee).
H. Keoteklian.
U.S. Patent No 4,173,532, 17 p, 6 Fig, 1 Tab, 6 Ref; Official Gazette of the United States Patent Office, Vol 988, No 1, p 176, November 6, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, *Separation techniques, Flocculation, Coagulation, Hydrogen ion concentration, Biochemical oxygen demand, Polyelectrolytes, Bakery effluents, Sugars, Starches.

The method of this invention broadly includes the sequential treatment of liquid industrial effluent with acidic and alkaline coagulants and cationic and anionic polyelectrolytes in a clarifier unit. The effluent is treated by the addition of an acidic coagulant to lower the pH and to enhance the removal of starches and sugars. The addition of acidic coagulant may be performed just prior to or at the entry of the effluent to the clarifier unit; alternatively, the acidic coagulant may be added to the liquid effluent while the effluent is in a holding tank. Once in the clarifier system, the effluent is treated by addition of an alkaline substance to raise the pH, thereby causing a voluminous and heavy floc to form in the clarifier. Another acidic coagulant is then added to the effluent in the clarifier for lowering the pH and for additionally forming floc. Anionic and cationic polyelectrolytes may be added to the clarifier at this point to enhance the ability of the floc to remove colloial materials. The heavy flocs and precipitates are removed from the bottom of the clarifier, while lighter flocs and precipitates are collected in a separate region. The remaining effluent, which is substantially free of waste materials can be either released to a suitable ground or surface receiving system or can to subjected to additional treatments before release. (Sinha-OEIS)
W80-02469

WASTE WATER PURIFICATION,
Standard Oil Co., Chicago, IL. (Assignee).
R. C. Mallatt, J. D. Walk, and J. F. Grutsch.
U.S. Patent No 4,168,288, 9 p, 1 Fig, 15 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 661, September 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Sewage treatment, *Separation techniques, Water purification, Activated carbon, Filtration, Aeration, Recycling, Regeneration.

An improved process for the treatment and purification of waste water comprises the use of primary, intermediate, and secondary treatment but tertiary treatment may also be included. Powdered activated carbon is used in the secondary treatment with recycle to any or all of the primary, intermediate or secondary treatment stages. Regeneration of used powdered activated carbon is also provided. In some cases, the improved process for the purification of waste water comprises feeding the waste water to a first clarification zone where easily removed solids are separated from the water; passing the effluent to a filtration of air flotation zone where suspended solids and colloidal matter are separated from the water; passing the effluent to an aeration zone where the water is contacted with activated sludge and powdered activated carbon, and oxygen is introduced; passing the effluent to a second clarification zone where purified water is separated from the sludge and carbon; recycling a first portion of the separated sludge and carbon from the second clarification zone to the filtration zone effluent; recycling a second part of the separated sludge and carbon to the first clarification zone effluent; and passing purified water from the second clarification zone. (Sinha - OEIS)
W80-02614

METHOD AND APPARATUS FOR RECYCLING WATER IN A CAR WASH,
For primary bibliographic entry see Field 3E.
W80-02616

WASTE WATER PURIFYING PROCEDURE,
Enso-Gutzeit Osakeyhtio, Helsinki (Finland). (Assignee).
M. Salkinoja-Salonen.
U.S. Patent No 4,169,049, 7 p, 2 Tab, 4 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 944, September 25, 1979.

Descriptors: *Patents, *Waste water treatment, Water pollution treatment, Industrial wastes, Aromatic compounds, Pulp and paper wastes, Chlorine, Phenols, Bacteria, Anaerobic conditions, Aeration, Biofilters.

A waste water purifying procedure is intended to be used in treatment of waste water containing aromatic compounds. In a biofilter in a layer containing bark of wood there is formed a bacterial population comprising one or several of the bactery strains deposited in the Universite of Helsinki Institute of General Microbiology under the deposition codes YM 134-202 and YM 241-268. The bacterial population was formed by packing into biofilters, crushed coniferous tree bark and bacteriferous water, ooze, mud or bark residues taken from a water body polluted by chlorinated and unchlorinated phenols and by aromatic carboxylic acids and by thereafter feeding into the biofilters water containing these substances, whereby the bactery strains are characterized by tolerance of the presence of chlorinated and unchlorinated phenols and of aromatic carboxylic acids. The waste water to be purified is conducted through the biofilter where the waste water is purified by effect of action of the bactery population. The purification may be carried out by conducting the waste water through three consecutive tanks. In that case anaerobic conditions are provided in the middle tank and the first and last tanks are biofilters, into which air is appropriately introduced for maintenance of bacterial activity. (Sinha-OEIS)
W80-02622

BUOYANT CONTACT SURFACES IN WASTE TREATMENT POND,
Solar Aquasystems, Inc., Encinitas, CA. (Assignee).
S. A. Serfling, and D. Mendola.
U.S. Patent No 4,169,050, 9 p, 4 Fig, 17 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 944, September 25, 1979.

Descriptors: *Patents, *Waste water treatment, *Biological treatment, *Settling basins, Aeration, Aquatic plants, Solar radiation, Food chains, Biological communities, Temperature.

A wastewater treatment and reclamation system uses natural ecological processes consisting of ponds; greenhouse pond cover; pollution-consuming, floating aquatic plants; high-surface-area, submerged, activated bio-web substrates for greatly increasing fixed bacterial film area and activity; aeration co-functioning with the bio-web substrate for accelerating bacterial metabolism and/or solar heat transfer, mixing and aerating the water body; and a polyculture of micro-invertebrates, fish and shellfish providing a balanced food chain for maximum removal and bio-concentration of nutrients and organics from the wastewater. (Sinha-OEIS)
W80-02623

METHOD OF TREATING WASTE WATERS CONTAINING SOLID-PHASE DIFFICULTLY-SOLUBLE COMPOUNDS,
Nippon Electric Co., Ltd., Tokyo. (Assignee).
N. Sakakibara, S. Ohno, and S. Shimizu.
U.S. Patent No 4,169,053, 4 p, 8 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 945, September 25, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Separation techniques, Heavy metals, Chemical reactions, Suspended solids, Chemical precipitation.

A method is provided for treating waste water containing solids of difficultly-soluble compounds of at least one heavy metal. The method comprises the steps of adding an amount of ferrous ions to the waste water corresponding on a molar basis to about 2 to 100 times the total molar amount of heavy metal present in the waste water, adding an alkaline substance in an amount corresponding to about 0.9 to 1.2 equivalent of free acid present in the waste water, and stirring the waste water without aeration at a temperature of at least about 40C. The insoluble ferrite crystals with the heavy metal incorporated within them are precipitated. (Sinha-OEIS)
W80-02624

PROCESS FOR CONCENTRATING AND PURIFYING AQUEOUS SULPHURIC ACID SOLUTIONS,
Montedison S.p.A., Millan (Italy). (Assignee); and Escher Wyss A. G., Zurich (Switzerland).
F. Cappello, M. Mortigliengo, E. Schmoll, and E. Kratz.
U.S. Patent No 4,169,054, 3 p, 3 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 945, September 25, 1979.

Descriptors: *Patents, *Waste water treatment, *Pollution abatement, *Separation techniques, Chemical wastes, Evaporation, Filtration, Metals, Sulfur compounds, Product recovery, Metal pickling industry, Sulfuric Acid.

Concentrated sulphuric acid aqueous solutions, stably clear through the time, are obtained starting from diluted sulphuric acid aqueous solutions containing Mg and possibly other impurities such as Fe, Al, Cr, V and Mn, by evaporation concentration. The process is characterized in that, before filtering, the slurry obtained by evaporation concentration, is cooled down to 10-25C. and maintained at this temperature for not less than 12 hours. (Sinha-OEIS)
W80-02625

APPARATUS AND PROCESS FOR VOLUME REDUCTION OF AQUEOUS WASTE THROUGH SOLAR EVAPORATION,
Waste Management, Inc., Oak Brook, IL. (Assignee).
V. R. Johnson, Jr., and W. O. Hagerman.
U.S. Patent No 4,169,791, 7 p, 6 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 987, No 1, p 169, October 2, 1979.

Descriptors: *Patents, *Waste water treatment, *Waste water disposal, *Evaporation, Industrial wastes, Heavy metals, Solar radiation, Settling basins, Equipment, Hazardous wastes.

A lagoon containing aqueous waste to be volume reduced is provided with a cover having one or more segments, each of which is mounted upon a frame and movable from a covering position to a position adjacent the lagoon. During fair weather, the cover is positioned adjacent the lagoon and liquid waste is pumped from the lagoon and dispersed over the surface of the cover. When inclement weather approaches, the pumping of the waste is ceased, the surface of the cover cleaned by flushing with clean water, and the cover moved into position over the lagoon to prevent precipitation from diluting the waste liquid. The invention is particularly useful in areas of low net evaporation rate. (Sinha-OEIS)
W80-02630

ENVIRONMENTAL, SMALL-PART CONTINUOUS WASHING PROCESS,
Mannor (J. S.) Machine Corp., Woodstock, IL. (Assignee).
M. Norman.
U.S. Patent No 4,170,488, 10 p, 5 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 407, October 9, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial water, Water pollution, Water reuse, Recirculated water, Conservation, Metal washing processes.

This process concerns a drum-type continuous washer for small parts. These parts, requiring oil or soil removal, are tumble washed. The continuous washing and rinsing process comprises a substantially closed chamber utilizing a hot, wash water collecting tank receiving, for recycling, condensate rinse and liquid spray run off from the process. It utilizes a compression section drawing in the steaming air from within the closed chamber for recycling. The tank included in a liquid path effects pressure spray impingement on the parts. The compression section included in a hot air path produces wet air by compression condensation of steam in air. The wash water in the collecting tank is maintained at a predetermined steaming temperature range and the blown condensed water is reintroduced into the heated tank for recycling. Each of the steps is performed in a closed chamber to minimize escape of heat, wash liquid, air, steam, rinse, and inhibitor. The recycling of wash liquid is also in a closed chamber to minimize escape of wash liquid. (Sinha-OEIS)
W80-02635

PROCESS FOR REDUCING AQUEOUS EFFLUENTS CONTAINING ENVIRONMENTALLY UNACCEPTABLE COMPOUNDS FROM A PROCESS FOR GASIFYING CARBONACEOUS MATERIALS,
Koppers Co., Inc., Pittsburgh, PA. (Assignee).
J. F. Kamody.
U.S. Patent No 4,170,550, 11 p, 2 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 425-426, October 9, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, *Recycling, Oxidation, Chemical reactions, Gases, Coal gasification wastes, Scrubbers.

Aqueous effluents from a process for gasifying carbonaceous materials may contain environmentally unacceptable compounds like hydrogen cyanide, ammonia, and ammonia compounds, dissolved salts and compounds of heavy metals and sulfur compounds. These compounds are removed from the aqueous effluents of the process by recycling the effluents to the gasifier where the compounds are oxidized, reduced, or decomposed into environmentally innocuous compounds that can be released to the atmosphere or removed from the gasification process in the residue. (Sinha-OEIS)
W80-02637

WASTE OIL RECOVERY UNIT,
British Petroleum Co. Ltd., London (England). (Assignee).
D. Honour.
U.S. Patent No 4,170,551, 4 p, 1 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 426, October 9, 1979.

Descriptors: *Patents, *Oil pollution, *Water quality control, *Waste treatment, Separation techniques, Oily water, Water pollution sources, Equipment, Bilge water, Oil wastes.

Waste oil on board ship is disposed of usefully by burning in the ship's steam raising boiler. Apparatus for rendering the waste oil burnable comprises a tank with waste oil and fuel oil inlets, a tank heater, a drain pipe and filter for separated water, an agitator, an external pipe and pump and pump for recirculation of waste oil and fuel oil through the turn and a bleed off pipe from the external pipe to the ship's boiler fuel supply line. Other liquid or finely powdered organic waste (e.g. kitchen waste) may also be disposed of in the system. (Sinha-OEIS)
W80-02638

METHOD FOR COALESCING MERCURY PARTICLES,
Anic S.p.A., Palermo (Italy). (Assignee).
G. Generini.
U.S. Patent No 4,170,552, 3 p, 4 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 426, October 9, 1979.

Descriptors: *Patents, *Waste water treatment, Water pollution treatment, Industrial wastes, Separation techniques, Mercury, Coalescence, Magnetic fields.

Mercury particles which are difficult to strip from sewage waters of industries employing mercury compounds, due to their extremely tiny size, can be coalesced into larger mercury drops by applying a strong magnetic field to the liquor which contains such tiny particles. (Sinha-OEIS)
W80-02639

PROCESS AND APPARATUS FOR THE CONTROLLED FLOCCULATING OR PRECIPITATING OF FOREIGN SUBSTANCES FROM A LIQUID,
GSI-Regeltechnik G.m.b.H (Germany, F.R.). (Assignee).

H. Lang, H. Overath, and H-W. Priester.
U.S. Patent No 4,170,553, 19 p, 11 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 426, October 9, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Domestic wastes, Separation techniques, Flocculation, Turbidity, Phosphates, Chemical precipitation, Equipment.

This invention relates to a process for the controlled flocculating or precipitating of foreign substances from waste water by the addition of a flocculating agent, at least a partial quantity of the liquid being treated with a dosed amount of the flocculating agent. The flocculation or precipitation caused in the partial quantity is measured by a turbidity measurement. The addition of the floccualting agent to the waste water is determined on the basis of the turbidity measurement. The apparatus for carrying out the process also constitutes the object of this invention. (Sinha-OEIS)
W80-02640

WASTEWATER TREATMENT METHOD,
United Aricraft Products, Inc., Dayton, OH. (Assignee).
I. G. Freshcorn.
U.S. Patent No 4,170,554, 5 p, 1 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 426-427, October 9, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Water pollution treatment, *Water quality control, *Separation techniques, Chemical precipitation, Chromium, Fluorides, Settling basins, Water purification.

A system of wastewater treatment is specifically improved in at least three areas. These conclude the carrying out of a continuous sensing of water quality in rinse tanks, with fresh water added as required to avoid contamination extremes which may make subsequent treatment difficult. In a second area of improvement, chromium and fluoride bearing wastewater is mixed in a common chamber to which is added a precipitant for simultaneous precipitation of the chromium as chromium hydroxide and of the fluorides as calcium fluoride. The pH in such chamber is carefully controlled to remain above an acidity level and below a level at which trivalent chromium will revert to hexavalent chromium. In a third area of improvement, treated wastewater is directed to a clarifier by way of a settling basin for a separating out of precipitated solids. Settled solids from the clarifier are returned to the settling basin for efficient separation with minimal water handling. Wastewater from other plant sources may also be directed to the clarifier, joining the metallic and salts bearing rinse water through at least a part of its treatment process. (Sinha-OEIS)
W80-02641

APPARATUS FOR RECOVERY OF METALS FROM METAL PLATING BATHS AND NEUTRALIZING TOXIC EFFLUENTS THEREFROM,
Instytut Mechaniki Precyzyjnej, Warsaw (Poland).
F. Tuznik, and A. Lis.
U.S. Patent No 4,171,255, 6 p, 1 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 987, No 3, p 680, October 16, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, *Metals, Separation techniques, Oxidation, Chemical precipitation, Filtration, Neutralization, Conservation, Product recovery, Metal plating industry, Cyanide.

A method and apparatus is provided for thorough neutralization of all plating bath solutions and effluents and for full recovery of used plating metals. Hexavalent chromium is reduced to trivalent chromium with production of chromium hydroxide. Metals such as zinc and cadmium are recovered as their respective hydroxides; silver and copper are recovered as free metals. The pH of the reclaiming bath is adjusted from 3.0 to 13.0, and an aldehyde, and/or ozone, is introduced into the reclaiming bath. The aldehyde may be introduced in the form of an aldehyde or an ammonium aldehyde. The fumes from the reclaiming tank are introduced into the fume extraction ducts which carry cyanide fumes in the form of hydrogen cyanide. The apparatus comprises three interconnected units. The first unit comprises the equipment for introducing the reagents into the reclaiming bath. The second unit comprises several tanks, or several chambers within one tank, which include equipment for filtration and precipitation within the closed-loop system of the plating bath and the reclaiming bath. The third unit comprises the reactor for pH adjustment and the water recovery installation, including piping and control systems. As filtration and purification of the plating bath, the reclaiming bath, and the rinse water are carried out within the closed-loop system, consumption of fresh water is reduced to 2-10%. (Sinha-OEIS)
W80-02643

PRESSURIZED OXYGENATION OF SEWAGE,
FMC Corp., San Jose, CA. (Assignee).
T. E. Roberts, Jr., B. M. Wright, C. D. Watson, and J. A. Abbott.
U.S. Patent No 4,171,263, 14 p, 15 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 987, No 3, p 682, October 16, 1979.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, Biological treatment, Oxygination, Dissolved oxygen, Activated sludge, Pressure, Equipment.

An activated sludge sewage treatment process includes a mixed liquor tank and a pressure vessel much smaller in size. All or a portion of the sewage influent to the mixed liquor tank is brought into the pressure vessel where oxygen is dissolved in the influent under pressures well above atmospheric. Then the influent is dropped to atmospheric pressure and directed into the mixed liquor tank in a gentle manner so that virtually all of the dissolved oxygen will remain under supersaturated conditions. This influent is then diluted with the material in the mixed liquor tank where the conventional sewage digestion process takes place under atmospheric conditions. It is critical to the process that the supersaturated solution be blended into the mixed liquor tank with a minimum of turbulence so that oxygen is not lost through ebullition prior to the mixing. (Sinha-OEIS)
W80-02644

METHOD FOR CONTINUOUSLY SEPARATING EMULSIONS,
Shell Oil Co., Houston, TX. (Assignee).
A. M. Benson, J. E. Heath, and M. A. Matovich.
U.S. Patent No 4,171,264, 4 p, 1 Fig, 2 Ref; Official Gazette of the United States Patent Office, Vol 987, No 3, p 683, October 16, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Oily water, Industrial wastes, Oil wastes, Separation techniques, Emulsions, Cellulose, Ballast water, Refinery effluents.

A method and an apparatus is described for continuously separating disperse phase and a continuous phase from a liquid-liquid emulsion. The emulsion, such as an oil-water emulsion, is flowed into a contacting zone in which the emulsion is agitated with continuous phase wet, disperse phase coalescing, length-classified chemically-pulped cellulose fibers and separated into a disperse phase and a continuous phase which are separately withdrawn. (Sinha-OEIS)
W80-02645

SUPPRESSION OF POLLUTION IN MINERAL FIBER MANUFACTURE,
Saint-Gobain Industries, Neuilly-sur-Seine (France). (Assignee).
J. A. Battigelli, and M-P. Barthe.
U.S. Patent No 4,171,265, 35 p, 18 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 987, No 3, p 683, October 16, 1979.

Descriptors: *Patents, *Waste water treatment, *Pollution abatement, *Water pollution control, Heat, Pressure, Resins, Gases, Conservation, Water reuse, Recycling, Fiber glass manufacturing.

A process, and the devices for implementing it, assures the suppression of harmful factors and permits the elimination of at least the majority of the ecologically objectionable pollutant elements contained in the gas or liquid wastes discarded by the manufacture of mineral fibers. The installation is for the manufacturing of fiber blanket, mat padding, or boards of mineral fibers and especially glass, agglomerated by thermosetting or thermoplastic binders, which coat the fibers and/or bring about close binding between fibers in the finished product. The invention is particularly concerned with recycling the majority of the fumes in the installation, and with treating and evacuating only a small portion of the fumes. Another object of the invention is to render insoluble the thermohardenable resins contained in the water. These resins are rendered insoluble by means of a heat treatment--preferably at a temperature greater than 100C, and under pressure. The application of this process is used to render insoluble the dissolved binder components contained in the water in order to subsequently be able to extract insoluble materials and thus to maintain the concentrations of the pollutants in the washing and cooling waters at a level compatible with the continuous re-utilization of these waters. The wash water thus circulates in a closed circuit and external rejection of pollutants with the wash water is eliminated. (Sinha - OEIS)
W80-02646

RECOVERY OF CALCIUM FLUORIDE FROM PHOSPHATE OPERATION WASTE WATER,
Occidental Chemical Co., Houston, TX. (Assignee).
R. J. Hirko, and H. E. Mills.
U.S. Patent No 4,171,342, 12 p, 1 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 987, No 3, p 705, October 16, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Chemical wastes, *Separation techniques, Phosphates, Chemical precipitation, Water reuse, Fluorides, Product recovery.

The invention is directd to a method for recovering fluorine and phosphate values from waste waters or pond waters resluting from the production of wet process phosphorc acid. It also provides a method of neutralizing the waste waters so they can be discharged into rivers and streams without fear of pollution or recycled as process waters in the production of phosphoric acid. The pond waters are treated with calcium carbonate and/or calcium oxide to remove a substantial portion of the remaining fluorine values as calcium fluoride. After removal of the calcium fluoride the filtrate is treated with calcium oxide to remove a substantial portion of the remaining fluorine values as calcium fluoride. After removal of these calcium flouride solids, the filtrate is treated with another charge of calcium oxide to produce dicalcium phosphate (dical) which is separated from the aqueous phase. The aqueous phase is treated with an additional charge of calcium oxide to remove a substantial portion of the solids leaving water that can be discharged or recycled. (Sinha-OEIS)
W80-02647

ENDING ACID MINE WATER POLLUTION,
Ground Water Age, Vol 14, No 1, p 25, 40, November, 1979.

Descriptors: *Acid mine water, *Mine drainage, *Water pollution control, *Lime, Water pollution treatment, Coal mine wastes, Mine acids, Acidic water, Water pollution sources, Acid streams, Soil filters, Lagoons.

A new technique to control pollution of water supplies due to acid mine drainage from abandoned deep coal mines is proposed. The acid mine water is diverted to a storage lagoon below the mine an is periodically allowed to flow through an area of limed soils. The water loses its acidity as it percolates through the soil. Advantages of this technique are low operating costs, no flooding problems, and

it can be used indefinitely by periodically adding lime to the soil. (Purdin-NWWA)
W80-02658

5E. Ultimate Disposal Of Wastes

THE FARMING OF DOVER SOLE AND TURBOT IN WARMED WATERS: THE WORK OF THE BRITISH WHITE FISH AUTHORITY IN 1976, 1977 AND 1978,
White Fish Authority, Ayrshire (England).
B. P. Thain.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun & Co., Montclair, p 97-107, 1979. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Fish farming, *Growth rates, *Aquiculture, Commercial fish, Fish management, Growth stages, Fish diets, Mortality, Spawning, Productivity, Fish hatcheries, Fish behavior, *Sole, *Turbot, *Solea, *Scophthalmus.

In 1976 the White Fish Authority completed a detailed economic forecast of the commercial costs of farming Dover sole (Solea solea) and turbot (Scophthalmus maximus). Subject to certain technical progress being achieved, this forecast concluded that both these species could be produced by farming methods at less than the market value of their wild counterparts. Until the 1977 season, juvenile production of Dover sole had been disappointing, although early-stage hatchery survivals (up to day 90) had been good. During 1977 considerable advancements were made, both in weaning the fish and in the amount of both live and inert diets ingested, with the result that, at an age of 350 days, some 150 kg of live juveniles, averaging 20g, were thriving and growing well at lower water flow rates than previously achieved. Manipulation of the environment led to an advancement in spawning of the sole by 54 days in 1977 and by 107 days in 1978. Hatchery and juvenile work with turbot, reported in December 1976, have been consolidated in 1977. Intensive feeding of young turbot in round tanks with good flow distribution demonstrated an increase in growth rate of 80% over previously recorded rates with fish held in rectangular tanks having relatively poor flow patterns. (Deal-EIS)
W80-02431

AN ANALYSIS OF FEEDING RELATIONSHIPS AMONG ESTUARINE FISHES RAISED IN POLYCULTURE IN PONDS RECEIVING THERMAL EFFLUENTS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 5A.
W80-02433

ECONOMIC EVALUATION OF THE USE OF THERMAL EFFLUENT IN LOBSTER CULTURE,
California Univ., Bodega Bay. Bodega Marine Lab.
L. W. Botsford, J. C. Van Olst, J. M. Carlberg, and T. W. Gossard.
In: Power Plant Waste Heat Utilization in Aquaculture, B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun and Co., Montclair, New Jersey, p 79-95, 1979. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Aquiculture, *Lobsters, *Thermal pollution, Powerplants, Heated water, Cooling water, Water temperature, Growth rates, Mortality, Animal metabolism, Cost analysis, Mathematical models, Commercial shellfish.

Determination of the advisability of using thermal effluent in aquaculture depends on extensive economic evaluation. In this paper we describe some of the considerations involved in that evaluation--those dealing with production costs. A mathematical model that describes the biological performance of the lobster in culture, the culture system, and costs of system components is used to project culture costs for various operating configurations that involve the use of thermal effluent. Alternative configurations include direct and indirect use of thermal effluent, heat recovery, water recirculation, and varying culture temperature. The method that provides the least cost of operation is determined for each of several ambient temperature regimes. Direct use of thermal effluent provides lower production costs than indirect for all temperature regimes. Indirect use of thermal effluent can lower culture costs in areas of moderate ambient temperature, but may not lower culture costs in areas of high or low ambient temperatures. (Deal-EIS)
W80-02435

BIOLOGICAL AND RADIOLOGICAL ANALYSIS OF THE POTENTIAL OF NUCLEAR POWER PLANT EFFLUENT WATERS FOR SHELLFISH CULTURE,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W80-02436

DISEASONAL WASTE HEAT AQUACULTURE: A THREE-YEAR REVIEW,
Trenton State Coll., NJ. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W80-02437

ON FISH CULTURE AND ON THE USE OF HEATED EFFLUENTS IN POLAND,
Instytut Rybactwa Srodladowego, Zabieniec (Poland). Pond and River Dept.
For primary bibliographic entry see Field 5A.
W80-02438

WASTE HEAT AQUACULTURE IN THE UNITED KINGDOM--A GENERAL REVIEW AND PARTICULARS OF MARINE FARM LTD., HINKLEY POINT, BRIDGWATER, SOMERSET, ENGLAND,
Marine Farm Ltd., Bridgewater (England).
For primary bibliographic entry see Field 5A.
W80-02439

OVERVIEW OF ONGOING SEA GRANT PROJECTS IN THE UNITED STATES UTILIZING HEATED WATER EFFLUENTS AND ITS FUTURE POTENTIAL,
National Oceanic and Atmospheric Administration, Rockville, MD. Office of Sea Grant.
W. N. Shaw.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun and Co., Montclair, New Jersey, p 243-246, 1979. 1 Tab, 10 Ref.

Descriptors: *Thermal pollution, *Aquiculture, *Research and development, Heated water, Water temperature, Powerplants, Fish farming, Shellfish farming, Salmon, Eels, Catfishes, Trout, Oysters, Clams, Shrimp, Lobsters, Productivity, Cost analysis, Fish hatcheries.

Presently, heated water effluents are being utilized in the United States to grow a variety of organisms: salmon, Macrobrachium, eels, catfish, trout, oysters, clams, shrimp, lobsters, etc. In almost all instances, this is being done at a research level of development as in Sea Grant's research in marine shrimp and lobsters. Commercial adaptation has been limited mainly to shellfish hatcheries. The future use of heated effluent will depend heavily on the results of present, on-going research. These results should lead to a pilot test operation and eventually, if the pilot operation appears commercially feasible, to a full-fledged commercial operation. It is the author's belief that heated water can play an important role in aquaculture, but may have to be limited to the hatchery aspects. (Deal-EIS)
W80-02440

DIRECT USE OF COOLING AND BLOWDOWN WATER FOR INTENSIVE FISH FARMING RESULTS OBTAINED IN A PILOT FACILITY AT THE NIEDERAUSSEM POWER PLANT,
Rheinisch-Westfaelishches Elektrizitaetswerk A.G., Essen (Germany, F.R.). Abt Anwendungstechnik.
For primary bibliographic entry see Field 5A.
W80-02441

JAPANESE AQUACULTURE WITH THERMAL WATER FROM POWER PLANTS--PRESENT CONDITION AND PROBLEMS,
Thermal Aquaculture Development Society of Japan, Tokyo.
T. Kuroda.
In: Power Plant Waste Heat Utilization in Aquaculture. B. L. Godfriaux, A. F. Eble, A. Farmanfarmaian, C. R. Guerra and C. A. Stephens, Editors, Allanhald and Osmun and Co., Montclair, New Jersey, p 247-259, 1979. 7 Fig, 1 Tab.

Descriptors: *Aquiculture, *Powerplants, *Thermal pollution, Nuclear powerplants, Thermal powerplants, Heated water, Cooling water, Water temperature, Sea water, Commercial fishing, Commercial fish, Commercial shellfish, Fish farming, Shellfish farming, Productivity, Cost analysis, *Japan.

An increasing number of conventional-type and nuclear power plants have been completed in Japan over recent years, the types which now account for about 75% of the country's electricity production. As energy demand grows year by year, more power generating units are planned to be built. Thermal and nuclear power plants both consume large quantities of cooling water for their condensers of steam. In consideration of Japan's geographical conditions, most of these installations use seawater for cooling and are therefore located in coastal areas. They release into the sea the heated seawater. Japan depends heavily on the fishing industry, and a large percentage of the Japanese population lives on offshore fishing in all coastal areas. Used water as released has a temperature 7 to 9C higher than the natural sea temperature. This appreciably affects marine life where thermal water is discharged. The range and degree of this effect varies largely from place to place, and studies are being done at various places concerned. Research work is also in progress to find ways to avoid wasting the thermal water and somehow to utilize its heat. So far, fairly satisfactory results have been obtained in aquaculture. The following is a report on the present state and problems in application. (Deal-EIS)
W80-02442

5F. Water Treatment and Quality Alteration

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. D. Fitzgerald, and E. R. Holley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-128960, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center, University of Illinois Research Report No 144, December 1979. 89 p, 30 Fig, 3 Tab, 12 Ref, Append. OWRT A-091-ILL (1).

Descriptors: *Mixing, *Diffusion, Jets, *Pipe flow, Water treatment, Discharge measurement, Mixing method, Mixing rates.

In order to mix an additive or a tracer with the fluid flowing in a pipe, it may be desirable to avoid the energy required and the possible maintenance problems for mixers or obstructions in a pipe and to avoid the relatively long flow length required for ambient mixing. Then, it may be advantageous to inject the additive as a jet into the pipe flow and to use the associated jet mixing to enhance the overall mixing process. Laboratory experiments were conducted to determine the rates of mixing with a single jet injection made at the pipe wall at various angles relative to the pipe wall and with

two diametrically opposed jets. For uniform pipe flow, it was possible to identify an optimum momentum for each angle of injection. A few experiments with induced swirl in the pipe flow showed that the swirl had a significant effect on the jet mixing, especially when two jets were used.
W80-02470

ELECTROLYTIC CELL FOR TREATMENT OF WATER SOLUTIONS,
Firma Hans Einhell G.m.b.H. Industriegelande, Landau (Germany, F.R.). (Assignee).
F. Stummer, and J. Miller.
U.S. Patent No 4,169,035, 6 p, 4 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 986, No 4, p 939, September 25, 1979.

Descriptors: *Patents, *Water treatment, *Water purification, *Electrolysis, Electrodes, Cathodes, Scaling.

The invention is an electrolytic cell for the treatment of aqueous solutions and consists of a closed container with an inlet and an outlet for the water flowing through the container, and has at least two electrodes which can be connected to the positive and negative poles of a direct current source. The electrolytic cell is characterized in that at least one electrode constitutes an electrical conductive body which can in itself be elastically deformed, preferably by bending and/or torsion. The result of these elastic deformations of the electrode, particularly of the cathode, is that the electrode or cathode is constantly flexion and torsion stressed so that in this way the formation of undesired deposits on the electrode or cathode is prevented. (Sinha-OEIS)
W80-02621

RESIN ADSORBENT TAKES ON CHLORORGANICS FROM WELL WATER,
Rohm and Haas Co., Spring House, PA. Research Div. Labs.
E. G. Isacoff, and J. A. Bittner.
Water & Sewage Works, Vol 126, No 8, p 41-42, August, 1979. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Adsorption, *Organic compounds, *Water wells, Activated carbon, Resins, Trichloroethane, Water treatment.

Gas chromatography was used to test the effectiveness of various adsorbents in removing trichloroethane from well water. A carbonaceous resin with a chemical composition intermediate between a polymeric adsorbent and activated carbon was found to be an excellent adsorbent. This resin, having a hydrophobic surface, is designed to remove low-molecular-weight, non-polar organics or halogenated organics from aqueous or gaseous streams. It can be regenerated in sites with stream or alcohol. The resin has greater physical strength and better regenerative flexibility than activated carbon and poliymeric adsorbents. (Purdin-NWWA)
W80-02654

5G. Water Quality Control

PARAMETER IDENTIFICATION OF TWO-DIMENSIONAL ESTUARINE MODEL,
California Univ., Los Angeles. Dept. of Engineering and Applied Science.
Wen-Sen Chu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127608, Price codes: A07 in paper copy, A01 in microfiche. PhD Dissertation, 1979, 113 p, 26 Fig, 7 Tab. (California Water Resources Center Project UCAL-WRC-W-530). OWRT B-191-CAL(1).

Descriptors: *Parametric hydrology, *Mathematical models, *Model studies, *Estuaries, Linear programming, Algorithms, Water quality, Salinity, Suisun Bay(CA).

Parameter identification in a two-dimensional vertically averaged estuarine model is studied. The unknown parameters which are optimally identified are the bottom roughness coefficient and the dispersion constants. A tidally averaged model is proposed as the forward solution scheme. The tidally averaged model is solved by an implicit-explicit iterative finite difference method. Error function method and linear programming are used in the identification algorithm. Both the forward solution scheme and the identification algorithm are first tested on a carefully designed hypothetical estuary. Suisun Bay in California is then selected for practical applications. Data are collected from the San Francisco Bay-Delta Hydraulic Model for the Suisun Bay study. Roughness coefficient and dispersion constants are successfully identified by the proposed methodologies. The results indicate that the general algorithm can be applied in other existing estuaries for both well-mixed and stratified conditions. Numerical results are given in detail. Discussion of this study and recommendations for future applications are also presented. (Snyder-Cal)
W80-02409

INTERNALIZING EXTERNALITIES OF PHOSPHORUS DISCHARGES FROM CROP PRODUCTION TO SURFACE WATER: EFFLUENT TAXES VERSUS UNIFORM REDUCTIONS,
Wyoming Univ., Laramie.
For primary bibliographic entry see Field 6B.
W80-02458

PROCESS FOR CHEMICAL DECONTAMINATION OF LAYERS OF EARTH AND/OR WATER CONTAMINATED WITH ORGANIC MATERIALS,
Aquatechnique Sierre S. A., Chippis (Switzerland) (Assignee).
E. Forte, and H. Schulthess.
U.S. Patent No 4,167,973, 6 p, 2 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 584, September 18, 1979.

Descriptors: *Patents, *Water quality control, *Organic wastes, *Water pollution, *Soil contamination, Soil treatment, Water treatment, Oxidation, Chemical reactions, Bacteriacides, Application equipment, Application methods.

There is provided an apparatus for the chemical decontamination of layers of earth and/or water contaminated with organic materials comprising the following block units: a device for withdrawal of water from a water pressure line which water is to be treated and returned into the layers of earth; a mixing device for the preparation of a mixture of water and at least one strong, chemical oxidizing agent and/or bactericide; a degassing device for removal of excess gas from the mixture; a distribution device for distributing the mixture to several feed lines; and several mobile sprinkling and/or feeding lines with drain pipes to feed the aqueous mixture to and/or the layers of earth whereby the drain pipes are at most lowered to the still water level in the water bearing layers of ground. There is also described a method of using the apparatus. (Sinha - OEIS)
W80-02612

SYNERGISTIC COMPOSITION COMPRISING PHOSPHORYLATED ETHOXYLATED GLYCERINE AND POLYACRYLIC ACID FOR THE PREVENTION OF CACO3 SCALE IN COOLING WATER,
Nalco Chemical Co., Oak Brook, IL. (Assignee).
G. T. Farley.
U.S. Patent No 4,168,230, 4 p, 1 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 662, September 18, 1979.

Descriptors: *Patents, *Water treatment, *Water quality control, *Cooling water, Industrial water, Scaling, Hardness(Water).

When certain low molecular weight polyacrylic acid salts are combined with an organic phosphate ester, an improved composition is afforded for preventing scale in industrial cooling systems. (Sinha-OEIS)
W80-02617

ENVIRONMENTAL POLLUTION FROM HIGHWAY DEICING COMPOUNDS,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5C.
W80-02657

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PARAMETER IDENTIFICATION OF TWO-DIMENSIONAL ESTUARINE MODEL,
California Univ., Los Angeles. Dept. of Engineering and Applied Science.
For primary bibliographic entry see Field 5G.
W80-02409

HYDROLOGIC EVALUATION OF THE STORMFLOW GENERATION PROCESS ON A FORESTED WATERSHED,
Pennsylvania State Univ., University Park. School of Forest Resources.
E. S. Corbett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-129133, Price codes: A07 in paper copy, A01 in microfiche. Ph.D. Thesis, November 1979. 139 p, 22 Fig, 36 Tab, 85 Ref. OWRT B-028-PA (5), 14-31-0001-3124.

Descriptors: *Forest watersheds, *Irrigation systems, *Rainfall, *Runoff forecasting, Soil moisture, Soil profiles, Analysis, Field capacity, *Hydrographs, Saturation, *Stream gages, *Hydrologic evaluation, *Stormflow generation process, Macropores, Experimental site, Quickflow, Delayed flow, Linear correlation coefficients.

In investigating the hydrologic behavior and response of a small forested watershed, an irrigation system was designed to apply a uniform amount of simulated rainfall to parts or all of a 19.59 acre experimental watershed in central Pennsylvania. To delineate the stormflow contributing areas and to evaluate their relative efficiency in converting rainfall into stormflow, a series of simulated rainfall applications were made, starting with the channel area and progressively increasing the application areas up the side slopes. The applications were made at both dry and wet antecedent soil moisture conditions and at three primary application amounts, 0.96, 1.50, and 1.92 inches. All rainfall applications were made at the rate of 0.24 inches per hour. There was a rapid reduction in the efficiency with which rainfall was converted to stormflow as distance from the perennial stream channel increased under dry antecedent soil moisture conditions. Under wet antecedent soil moisture conditions, the watershed contributed to stormflow in a more uniform manner and the stormflow components became highly correlated with storm amount. There was a large increase in the efficiency with which the middle and upper slope soil zones converted rainfall into quickflow as positive hydraulic gradients became established in these areas of the watershed. The percent of rainfall converted into quickflow ranged from 1.6 to 75.8 percent over the measured range of soil moisture conditions. (Tsong-Pennsylvania)
W80-02474

THE YAMPA RIVER BASIN, COLORADO AND WYOMING--A PREVIEW TO EXPANDED COAL-RESOURCE DEVELOPMENT AND ITS IMPACTS ON REGIONAL WATER RESOURCES,
Geological Survey, Lakewood, CO. Water Resources Div.
T. D. Steele, D. P. Bauer, D. A. Wentz, and J. W. Warner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-300 815, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-126, September 1979. 133 p, 35 Fig, 16 Tab, 124 Ref.

Descriptors: *Environmental effects, *Mining, *Coal mine wastes, *Water resources, *Water

quality, Regional analysis, Colorado, Wyoming, River basins, Water supply, Water rights, Water demand, Water pollution control, Surface waters, Groundwater, Land use, Public lands, Planning, Evaluation, *Yampa River basin(Colo-Wyo), Residuals management.

Expanded coal production and conversion in the Yampa River basin, Colorado and Wyoming, may have substantial impacts on water resources, environmental amenities, and socioeconomic conditions. Preliminary results of a 3-year basin assessment by the U.S. Geological Survey are given for evaluation of surface- and ground-water resources using available data, modeling analysis of waste-load capacity of a Yampa River reach affected by municipal wastewater-treatment plant effluents, and semiquantitative descriptions of ambient air- and water-quality conditions. Aspects discussed are possible constraints on proposed development due to basin compacts and laws regulating water resources, possible changes in environmental-control regulations, and policies on energy-resource leasing and land use that will influence regional economic development. (Woodard-USGS)
W80-02582

FLOW ROUTING IN THE SUSQUEHANNA RIVER BASIN: PART III - ROUTING RESERVOIR RELEASES IN THE TIOGA AND CHEMUNG RIVERS SYSTEM, PENNSYLVANIA AND NEW YORK,
Geological Survey, Harrisburg, PA. Water Resources Div.
J. T. Armbruster.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-301 393, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-85, July 1979. 34 p, 12 Fig, 6 Tab, 15 Ref.

Descriptors: *Model studies, *Reservoir releases, *Streamflow, *Routing, *Low-flow augmentation, Simulation analysis, Planning, Pre-impoundment, Evaluation, Regulated flow, Analytical techniques, Drainage area, New York, Pennsylvania, *Susquehanna River Basin Commission, *Tioga and Chemung Rivers System (PA-NY).

Channel-routing models were used to route hypothetical releases from reservoirs in the upper Tioga River basin, Pennsylvania. These releases were routed northward down the Tioga River to Lindley, Erwins, and Corning, New York: combined with flows routed down the Cohocton River from Campbell to Corning, New York; and then routed southeastward down the Chemung River from Corning to Chemung, New York. The models used to route the flows of Cohocton and Chemung Rivers accounted for bank-storage discharge and streamflow depletion by well pumpage. In general, 17 water years of concurrent streamflow data were available for model calibration and verification. Three hypothetical reservoir releases were made from the reservoirs and routed to Wilkes-Barre, Pennsylvania, using the models developed in this study and models developed downstream to Wilkes-Barre in a previous study. A hypothetical makeup water requirement of 65 cubic feet per second was assumed. Two historical low-flow periods were investigated. The first hypothetical release investigated was a constant 100 cubic feet per second, and the second release was a constant 70 cubic feet per second. The third scheme was a hypothetical release of 100 cubic feet per second for three days followed by a constant 70 cubic feet per second for the duration of the period considered. Constant 100 cubic feet per second releases arrived downstream more quickly than constant 70 cubic feet per second releases for both test periods, but delivered more water than required to satisfy the assumed makeup requirement. The third release scheme was generally the most efficient of the three schemes tested. (Woodard-USGS)
W80-02586

A PROBABILISTIC OPTIMIZATION MODEL FOR WATER RESOURCES CAPACITY EXPANSION WITH PRICE-SENSITIVE SEASONAL DEMAND,
California Univ., Los Angeles. School of Engineering and Applied Science.
B. Nieh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-139553, Prices codes: A10 in paper copy, A01 in microfiche. Ph. D. Dissertation, 1979. 179 p, 26 Fig, 23 Tab, 5 Append. (California Water Resources CTR Proj UCAL-WRC-W-518). OWRT-A-062-CAL(3).

Descriptors: *Optimization, *Computer model, *Mathematical models, *Probability, Size, Time, Investment, Reservoirs, Water conveyance, Desalination plants, Economics, Operating costs, Financial analysis.

This study presents the development and application of a mathematical programming model for planning regional water resources capacity expansion when seasonal demands are price dependent and inflows are stochastic. This multi-planning period model simultaneously considers the investment and allocation (pricing) decisions associated with the present and future water resources development. The procedure consists of selecting the sizing, sequencing and timing of investment in surface reservoirs, water conveyance facilities, seawater desalting plants that maximizes the present worth of the total expected benefits (consumers' willingness-to-pay) less investment costs, operating costs and future debts. Groundwater storage is considered an integral part of this selection. Instream quantity requirements for quality control and a revenue constraint that requires the total discounted revenues must cover the total discounted costs are explicitly considered in this optimization model. Long-run seasonal price-sensitive bulk water demand is a key variable in this investment planning model. It serves both as an indicator of water value and as a feedback signal to consumers, reflecting the cost of investments required to satisfy particular demand. The mathematical programming model that if formulated is large scale and has both binary and linear constraints. A mixed integer linear programming code based on a branch-and-bound algorithm is used to obtain solutions to the model. (Snyder - Cal)
W80-02606

AN IMPROVED MONTE CARLO PROCEDURE FOR THE SOLUTION OF THE STEADY-STATE, TWO-DIMENSIONAL DIFFUSION EQUATION WITH APPLICATION TO FLOW THROUGH POROUS MEDIA,
Kansas Univ., Lawrence. Dept. of Mechanical Engineering.
J. H. Turner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-132616, Price codes: A09 in paper copy, A01 in microfiche. M Sc Thesis, (1979), 191 p, 18, 7 Append, OWRT B-045-KAN (2) 14-34-0001-6079.

Descriptors: *Floating random walk, *Monte Carlo method, *Diffusion, Porous media, *Diffusion equation, Heat conduction, Evaluation.

Monte Carlo procedures for solving the diffusion equation of heat conduction and flow through porous media have been known for some years. Various investigators have indicated that the so-called floating random walk Monte Carlo procedure offers advantages in terms of computer execution time for single point solutions and complex geometries over finite difference procedures. This work investigates an improvement to the floating random walk. The improvement is based upon the use of exact analytical solutions to the diffusion equation interpreted in probabilistic form. A comparison is made for a number of test cases between what is referred to as a conventional Monte Carlo procedure and the improved Monte Carlo procedure. In addition, a comparison is made to an ADI finite difference procedure. The results indicate that the improved Monte Carlo procedure is more efficient than the conventional Monte Carlo procedure in terms of computer execution time and is competitive with, and may even be superior to, the ADI finite difference procedure in some cases.
W80-02607

6B. Evaluation Process

MARINE RESOURCES: THE ECONOMICS OF US OCEAN POLICY,
Washington Univ., Seattle.
J. A. Crutchfield.
American Economic Review, Vol 69, No 2, p 266-271, 1979.

Descriptors: *Marine resources, *Economics, *Water resources development, *International waters, *Oceans, Sea water, Desalination, Manganese nodules, Marine fisheries, Oil, Mineral industry, Surveys, Salts, Natural gas, Energy, Costs, Benefits, Dredging.

Present and potential prospects for marine resources development are discussed within the framework of the supply and demand on these resources from all sources. It is concluded that the present value of most mineral resources is near zero. Their significance is in the ceiling they impose on future increases in prices for the same minerals from land sources. Power from tidal sources or temperature gradients, desalination of sea or brackish water for human consumption, and exploitation of hard rock minerals, dissolved minerals such as sand and gravel, phosphorite and ferro-manganese nodules are placed in this category. Currently, unconsolidated minerals offer the most important prospect. Annual production of sand and gravel by inshore dredging is estimated at about $80 million for 1976. Copper, nickel, cobalt and manganese in ferro-manganese nodules are potentially important since they are metals imported by the U.S., but capital requirements are high and legal title uncertain. Offshore petroleum and natural gas is valuable, being produced along the coasts of some 50 nations, but it is not necessarily in the interest of the U.S. of the world community to rush its production. World production of fish has risen from 20 million metric tons in 1946 to 70 million in 1970. However, most of the increase has been in industrial production for meal and oil; there has been no increase for direct human consumption. Utilization and management of this living resource of the sea has been poor, with constant pressure toward depletion or destruction of the fishery, and the use of more gear and labor than is required for its harvest (Luedtke-Wisconsin)
W80-02449

THE ECONOMICS OF MARINE FISHERIES MANAGEMENT IN THE ERA OF EXTENDED JURISDICTION: THE CANADIAN PERSPECTIVE.
Simon Fraser Univ., Burnaby (British Columbia).
For primary bibliographic entry see Field 6E.
W80-02450

POSSIBLE DEVELOPMENTS IN U.S. AND GLOBAL FISH MARKETS DUE TO EXTENDED JURISDICTION AND A PROPOSED RESEARCH AGENDA,
Synergy, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W80-02451

A MACROECONOMIC ANALYSIS OF REGIONAL ENVIRONMENTAL MODELING AND PLANNING,
Wyoming Univ., Laramie. Dept. of Economics.
D. S. Brookshire.
Journal of Environmental Economics and Management, Vol 5, No 3, p 268-281, 1978. 4 Tab, 17 Ref, 2 Append.

Descriptors: *Regional analysis, *Economic efficiency, *Model studies, *Environmental quality, *Pollution abatement, Southwest US, Regional economics, Investment, Disamenities, Multipliers, Trade model, Economics.

An approach to environmental quality control in the framework of two interregional trade models is presented. Alterations in the institutional structure of a region through exogenous investments are shown as a tool for regional adjustments in envi-

ronmental quality. An expanded Metzler interregional model which incorporated regional disamenities into the multiplier structure is demonstrated, along with a regional migration model for estimating regional disamenities; the latter model suggests that a concept of aggregate efficiency should be established for allocating large exogenous investment expenditures across regions. An example of the approach uses data for the Southwestern U.S. Revised regional multipliers which include disamenities levels are calculated and investment decisions are considered with and without disamenity effects. The example suggests that failure to include disamenity corrections in regional multipliers will lead to greater regional inequality in welfare. Rankings of states varies considerably between the corrected and uncorrected cases. A major shortcoming of the approach is that it does not differentiate rural versus nonrural considerations. (Luedtke-Wisconsin)
W80-02452

PUBLICLY VESTED VALUES FOR FISH AND WILDLIFE: CRITERIA IN ECONOMIC WELFARE AND INTERFACE WITH THE LAW,
Fish and Wildlife Service, Sacramento, CA. Water Policy Center.
P. A. Meyer.
Land Economics, Vol 55, No 2, p 223-235, May 1979. 1 Tab, 36 Ref.

Descriptors: *Market value, *Wildlife, *Fish, *Willingness to pay, *Compensation, Welfare economics, Theoretical analysis, Evaluation, Legal aspects, Economics, Recreation.

The economic basis for estimating fish and game values is reviewed and compared with current recreational area use. Welfare economics distinguishes between the amount owners are willing to pay for the resource and the compensation required by those who lose it when public fish and game resources are destroyed. It is commonly presumed that the value difference between willingness to pay and demand for compensation is not great. This study suggests that willingness to pay does not differ from need to be compensated only for relatively small environmental products. Display of all compensatory demands on an offer curve (a schedule of the number of respondents willing to sell their rights to the public good being studied at each of a series of possible prices) allows all data to be considered, overcoming shortcomings of a single number estimate which frequently excludes from the cost benefit analysis those least willing to experience environmental loss. Also examined is the interface between legal and economic principles as it affects the evaluation of fish and game losses. Conclusions: (1) Proper evaluation practices may be supported by law where gains and losses are distributed between differing jurisdictional groups. (2) Principles of public trust or police powers may provide a basis for calculation of compensatory damages. (3) Where legislators, the courts or administrators attempt to go beyond ordinary regulatory process to deal with public welfare, economic principle requires that the compensatory needs of those experiencing losses be considered. (Luedtke-Wisconsin)
W80-02454

RECLAMATION POLICY AND THE WATER SUBSIDY, AN ANALYSIS OF THE DISTRIBUTIONAL CONSEQUENCES OF EMERGING POLICY CHOICES,
California Univ., Davis. Dept. of Agricultural and Resource Economics.
E. P. LeVeen, and G. E. Goldman.
American Journal of Agricultural Economics, Vol 60, No 5, p 929-934, December 1978. 1 Tab, 10 Ref.

Descriptors: *Federal Reclamation Law, *Costs, *Benefits, *Irrigation programs, *Water subsidy, Rural development, Family farms, Irrigation, Income distribution, Westlands, Water users, Cost repayment, Water costs, Social aspects.

The magnitude and inequality of distribution of water subsidy in Reclamation Act irrigation projects is examined with respect to current administration of the law and to proposed changes. Originally very little subsidy was included in the Reclamation program, with users required to repay full project cost less interest within 10 years. However, due to an extension of the repayment period to 40 years, use of hydroelectric power revenues to offset some irrigation costs, effects of inflation, and an additional subsidy resulting from a much lower power rate charged for pumping irrigation water, water users now pay only a small fraction of all irrigation costs. Requiring users to repay full costs would raise fees an average of 17 times present levels. While irrigation projects increase the productivity and economic value of private lands, there is no clear relationship between this increased value and the public costs of a project. In addition, original land owners received most of the windfall projects benefits, averaging $1.45 million per-owner of excess land in the Westlands example, and very few new farms were created. Of proposed changes in the administration of the law, only strict enforcement of the existing laws would provide a substantially wider distribution of subsidy benefits. In the Westlands case, the imposition of these requirements would create only 1400 new farms at a public expenditure of one billion dollars. Benefits would still be over $20,000/yr in addition to the usual return. It is concluded that alternative policies be explored to more effectively promote family farming and rural development. (Luedtke-Wisconsin)
W80-02455

INTERNALIZING EXTERNALITIES OF PHOSPHORUS DISCHARGES FROM CROP PRODUCTION TO SURFACE WATER: EFFLUENT TAXES VERSUS UNIFORM REDUCTIONS,
Wyoming Univ., Laramie.
J. J. Jacobs, and G. L. Casler.
American Journal of Agricultural Economics, Vol 61, No 2, p 309-312, May 1979. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Phosphorus, *Efficient tax policy, *Economic efficiency, *Farm management, *Uniform reduction policy, *Social aspects, *Pollution taxes(charges), Fall Creek(NY), Lake Cayuga(NY), New York, Soil erosion, Surface runoff, Crop production, Linear programming, Total costs, Costs, Effluents, Political constraints.

Social costs and costs of farmers of achieving given levels of phosphorus discharge reduction from crop production for effluent taxes are empirically compared to a uniform reduction policy in the Fall Creek watershed, New York. The cost of reducing phosphorus discharges due to surface runoff and soil erosion by 10% to 60% was estimated with a linear programming model of the agricultural production sector of the watershed. Results indicate that the effluent tax policy allows each level of phosphorus discharge reduction to be achieved more efficiently than the uniform reduction policy in terms of social cost to socity. However, the total cost to the farmer is much greater for the tax policy than for the uniform reductions policy. The required effluent tax when added to the reduction in income, makes the total cost to the farmer 2.7 to 13.3 times higher, which may not make the effluent tax policy politically feasible or equitable. An alternative effluent tax policy is proposed which would preserve the lower social costs benefits of an effluent tax and yet not be so charged on the desired level of discharge. This would allow economically efficient achievement of discharge goals and keep the total cost to the farmer as low or lower than that of the uniform reduction policy. (Luedtke-Wisconsin)
W80-02458

1977 MARKET FOR WATER AND WASTEWATER TREATMENT EQUIPMENT,
Bureau of Domestic Business Development, Washington, DC. Office of Business Policy Analysis.
K. L. Kollar, and J. Matticks.
Journal of the Water Pollution Control Federation, Vol 51, No 4, p 672-688, 1979. 1 Fig, 13 Tab, 1 Append.

Descriptors: *Marketing, *Industrial production, *Equipment, *Waste water treatment, *Sales, Municipal water, Industrial water, Municipal wastes, Industrial wastes, Market value, Surveys, Utilities, Treatment facilities, Costs, Industrial plants, Effluents, Recirculated water, Construction.

A survey of water and wastewater treatment equipment manufacturers was conducted in 1977 by the U.S. Department of Commerce for industrial mobilization planning purposes to update similar surveys completed in 1965, 1968, 1970. This report summarizes and compares data from the 1970 and 1979 surveys, disaggregating the market by municipal water supply, industrial wastewater treatment, and municipal wastewater treatment. The surveys are based on manufacturers' responses to a questionnaire on manufacturing plant production capacity and value of equipment shipments. Municipalities and industry spent more than $820 million for water and wastewater treatment equipment in 1977, an increase of $472 million over that spent in 1970. Nearly two-thirds, $536 million, was spent on wastewater treatment equipment ($355 million by municipalities and $181 million by industry), while $285 million was for water treatment equipment ($123 million by municipalities and $162 million by industry). This represents a nearly 135% increase in total equipment sales since 1970. While both water and wastewater equipment markets grew significantly between 1970 and 1977, the growth in wastewater equipments sales was nearly three times that for water treatment equipment sales. This market is dominated by relatively few firms, with 50 plants reporting more than 75% of total shipments. Twenty-three major categories of equipment are reported. Production capacity of the industry averaged about one-half of potential manufacturing capacity. (Luedtke-Wisconsin)
W80-02460

THE GROUND-WATER GEOTHERMAL HEAT PUMP: AN IDEA WHOSE TIME HAS COME,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 8C.
W80-02649

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

RECLAMATION POLICY AND THE WATER SUBSIDY, AN ANALYSIS OF THE DISTRIBUTIONAL CONSEQUENCES OF EMERGING POLICY CHOICES,
California Univ., Davis. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6B.
W80-02455

CONCEPTS OF VALUE FOR MARINE RECREATIONAL FISHING,
Illinois Univ. at Urbana-Champaign, Dept. of Forestry.
J. F. Dwyer, and M. D. Bowes.
American Journal of Agricultural Economics, Vol 60, No 5, p 1008-1012, December 1978. 22 Ref.

Descriptors: *Fishing, *Cost-benefit analysis, *Methodology, Sea water, Recreation demand, Willingness to pay, Willingness to sell, Compensation, Value, Economics, Fish management, Resources development, Costs, Benefits, Travel cost method, Survey based method, Hedonic pricing.

Cost/benefit procedures for estimating changes in marine recreational fishing benefits under various resource management options are discussed. Maximum willingness to pay is used to measure gains in benefits due to such options as an increased stock of fish, while minimum desired compensations or willingness to sell is used to measure losses. Both concepts are estimated from a demand curve for recreation at a particular area. Travel cost and survey methods are used to estimate demand for and value of marine recreational fishing. Fishing quality is affected by many resource management decisions and also must be included in the analysis. This includes fishing success rate at particular sites, number of fish caught, congestion in the fishing area, services provided by charter industries, catch

composition, size of fish caught, and weather or sea conditions. Major improvements being made in the travel cost method include better procedures for building in substitutes, quality, and traveltime, and applying the model to new types of situations. Survey methods have received less attention, but recently have been used by the U.S. Fish and Wildlife Service. A component of this, the hedonic pricing approach, provides a new approach to evaluation of changes in quality. (Luedtke-Wisconsin)
W80-02456

INTERNALIZING EXTERNALITIES OF PHOSPHORUS DISCHARGES FROM CROP PRODUCTION TO SURFACE WATER: EFFLUENT TAXES VERSUS UNIFORM REDUCTIONS,
Wyoming Univ., Laramie.
For primary bibliographic entry see Field 6B.
W80-02458

WATER USER DEMAND: COST ALLOCATION AND TAXATION,
Montreal (Quebec).
For primary bibliographic entry see Field 6D.
W80-02459

PRICING PROBLEMS IN AN INPUT-OUTPUT APPROACH TO ENVIRONMENT PROTECTION,
Linacre Coll. Oxford, (England).
R. Lowe.
The Review of Economics and Statistics, Vol 61, No 1, p 110-117, 1979. 3 Tab, 1 Ref.

Descriptors: *Input-output analysis, *Pollution abatement, *Theoretical analysis, Standards, Pricing, Effluent taxes, Pollution taxes(Charges), Taxes, Costs, Value added taxes, Sales taxes, Linear programming, Mathematical models, Industrial production, Shadow prices.

Leontief's input-output model for pollution pricing is placed in a broader theoretical framework, using a linear programming objective to choose among production techniques and abatement activities when pollution standards are imposed. A dichotomy is revealed between the role of ordinary dual-shadow variables as economic opportunity costs and of quasi-dual variables as prices under competitive minimization. This dichotomy, which arises because untreated net pollution is discharged free to final consumers, shows that the determination of antipollution costs and their impact on industrial prices is not identical to the opportunity costs of environmental restriction in terms of extra value added to or lost final demand. Three ways of financing pollution through taxation are considered: (1) state value-added taxes, (2) final sales taxes, and (3) effluent taxes. The examples emphasize that quasi-dual variables provide the correct financial basis for balanced input-output accounts, whether concerned with private abatement or state-operated schemes financed through any of the three methods. In each case, these taxes provide sufficient revenue to eradicate pollution to a desired standard, thus enabling both taxes and standards to be contained within a common framework. (Luedtke-Wisconsin)
W80-02461

INTEGRATED PLANNING OF A METROPOLITAN WATER AND WASTEWATER SYSTEM WITH PRICE SENSITIVE WATER-WASTEWATER SERVICE DEMANDS,
California Univ., Los Angeles. Dept. of Engineering Systems.
S. K. Mozumder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-130271, Price codes: A08 in paper copy, A01 in microfiche. Ph.D. Dissertation, 1979. 154 p, 23 Fig, 33 Tab, 66 Ref, Append. (California Water Resources CTR Proj UCAL-WRC-W-518), OWRT-A-062-CAL(2).

Descriptors: *Water supply, *Water reuse, *Waste water(Pollution), *Waste water disposal, Water costs, Economics, Municipal wastes, Model studies, Computer models.

A multi-faceted water-wastewater development scheme for a metropolitan area articulated over multi-seasons and multi-time periods is presented. Water-wastewater 'development' through acquisition of more local surface and groundwater, external import, reclaimed water reuse, reallocations of consumptions among competing sectors, and conservation by invoking economic measures is considered. A deterministic approach of analyzing water-wastewater development planning, using mixed-integer programming technique, is proposed. The objective of the analytical solution is to maximize discounted value of net benefits attributable to the water-wastewater services of a metropolitan area within a specified time-horizon. Temporal decisions specifying the quantities extracted and recharged to groundwater, imported from external sources, and reused from wastewater reclamation plants to meet potable and non-potable demands are provided by the solution. Also, the results incorporate selection of efficient water-wastewater projects (timing and sizing of water-wastewater treatment, storage and distribution facilities). To demonstrate the workability of the analytical framework, an example problem based on the data made available from Santa Clara Valley Water District of Northern California was solved. (Snyder-California)
W80-02605

6D. Water Demand

WATER USER DEMAND: COST ALLOCATION AND TAXATION,
Montreal (Quebec).
S. Jack, C. Barube, and H. Demard.
Journal of American Water Works Association, Vol 71, No 4, p 194-196, 1979. 3 Tab, 6 Ref.

Descriptors: *Water demand, *Water allocation(Policy), *Water rates, *Saint Foy(Quebec), Water users, Water utilization, Costs, Taxes, Water works, Water distribution(Applied), Municipal water, Methodology, Quebec, Canada.

The impact of user demand on the design and operation of the Saint Foy, Quebec, municipal water system is analyzed. A method for allocating joint water costs to individual user groups is developed and a tax structure oriented to demand management is suggested. The water capacity needed by each used group is identified. User demand is evaluated over the following time frames: average daily, peak daily, hourly and instantaneous. Residential and commercial users are defined according to their demand characteristics which are then related to the required components of the water system. This allows system costs to be assessed to particular user groups according to the capacity required in the component to meet each groups demand. The allocation of system component capacity to its three elements, actual user demand, potential demand, and indirect demand, is accomplished by linear and marginal methods. Since costs are to be recovered according to service rendered, the replacement cost of components is an equitable basis for cost allocation. Demand management and financial yield, equity, control of urban development and the customers ability to pay are the principles upon which the proposed tax structure is based. (Luedtke-Wisconsin)
W80-02459

STUDIES ON THE INFLUENCE OF MAN (ANGLING) ON FRESHWATER FISH POPULATIONS IN SOUTHERN POLAND,
Polish Academy of Sciences, Krakow. Inst. of Biology.
For primary bibliographic entry see Field 6G.
W80-02487

EXPLOITATION OF FISHERY RESOURCES IN LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 6G.
W80-02488

AVAILABILITY AND USE OF WATER IN NEBRASKA, 1975,
Geological Survey, Lincoln, NE. Water Resources Div.
R. Bentall, and F. B. Shaffer.
Nebraska Water Supply Paper Number 48, June 1979. 121 p, 27 Fig.

Descriptors: *Nebraska, *Water supply, *Available water, *Water utilization, Irrigation, Municipal water, Domestic water, Industrial water, Livestock, Electric powerplants, Hydroelectric power, Surface waters, Groundwater, Reservoirs, Lakes, Ponds, Hydrology, Evaporation, Precipitation(Atmospheric).

Water supplies available for use and the uses made of those supplies in Nebraska during the 1975 water year are evaluated. Available supplies that year consisted of holdover storage in surface reservoirs (combined capacity of principal reservoirs, 3.05 million acre-feet), lakes and ponds, groundwater storage (estimated at 1.875 billion acre-feet), canal and river inflow (1.71 million acre-feet), and precipitation (80.5 million acre-feet). Use of reservoir releases and water diverted from flowing streams plus water pumped from wells totaled 9.91 million acre-feet. An additional 6.34 million acre-feet was used for generating hydroelectric power. About 83 percent of the 9.91 million acre-feet was used for irrigation and the remaining 17 percent was used for municipal, rural domestic, and livestock supplies, for cooling at fuel-electric plants, and by industries not supplied by municipal water systems. About 72 percent of the water used for irrigation was obtained from wells. An analysis of streams discharges indicated that seepage from ground-water reservoirs accounted for about 55 percent of total streamflow in water year 1975. However, ground water constituted slightly less than half the outflow from Nebraska because overland runoff to streams is greatest in the part of the State where use of surface water is minimal and most of the outflow occurs. (Woodard-USGS)
W80-02592

6E. Water Law and Institutions

FLORIDA'S 'REASONABLE BENEFICIAL' WATER USE STANDARD: HAVE THE EAST AND WEST MET,
Florida Univ., Gainesville.
F. E. Maloney, L. C. Capehart, and R. S. Hoofman.
University of Florida Law Review, Vol 31, No 2, p 253-83, Winter 1979. OWRT B-030-FLA(2), 14-34-0001-7113.

Descriptors: *Florida, *Water permits, *Water allocation(Policy), Legislation, Judicial decisions, Beneficial use, Reasonable use, Common law, Water policy, Water rights, Consumptive use, Water law.

In 1972, a year of major environmental legislation in Florida, the legisalture made changes in the system of water management through enactment of the 1972 Florida Water Resources Act (FWRA). The FWRA is designed to provide comphrehensive and hydrologically sound state regulation of Florida's water resources. The FWRA provides for establishment of a permit program for consumptive water use. To obtain a permit, the applicant must establish that the proposed use: (1) is a reasonable beneficial use; (2) will not interfere with any presently existing legal use; and (3) is consistent with the public interest. Reasonable beneficial use is defined as the use of water in such quantity as is necessary for economic and efficient utilization for a certain purpose reasonable and consistent with the public interest. The meaning of a reasonable beneficial use is examined through analysis of the common law of both reasonable use and beneficial use. Factors develop to assist administrative agencies in establishing guidelines for determination of whether a proposed use satisfies the reasonable beneficial standard are also set forth. (Ewing-Florida)
W80-02415

THE ECONOMICS OF MARINE FISHERIES MANAGEMENT IN THE ERA OF EXTENDED JURISDICTION: THE CANADIAN PERSPECTIVE.
Simon Fraser Univ., Burnaby (British Columbia).
P. Copes.
The American Economic Review, Vol 69, No 2, p 256-260, May 1979. 9 Ref.

Descriptors: *Marine fisheries, *Fish management, *200 mile economic zone, *Evaluation, *Canada, Political aspects, Benefits, Economic efficiency, Foreign trade, Coasts, International waters, Commercial fishing, Resources development, Management, Economics, Informal Composit-Negotiating Text.

The 200-mile economic zone, as reflected by the Informal Composite Negotiating Text, is proving beneficial in regeneration of resource rents and restoring overfished coastal stocks. Distribution of resulting benefits favors coastal nations and their allocation will be affected by interzone boundary determinations and by trade diversions. Being sole owners of fish stocks allows for more rational resource management and helps extend fishing operations of coastal nations at the expense of distinct-water operations. However, the territorial definition of fisheries jurisdiction has limited the effectiveness of the new management regimes with uncertain effects on transboundary stocks and has reduced access to distant-water fleets may lead to further over-exploitation in the high seas. Canada's experience with the 200-mile limit is used to illustrate opportunities and problems of extended jurisdiction. The pressure for excessive effort in the 200 mile fishery has not changed, but Canada is now able to reserve larger stocks to accommodate that pressure. In addition, a beneficial short-run accommodation has been arranged with foreign fishing fleets to harvest stocks which Canada cannot harvest economically at this time. The potentially most serious threat is that distant water fleets, displaced from the 200 mile zone, will divert their attention to high seas salmon of North American origin and other transboundary stocks. (Luedtke-Wisconsin)
W80-02450

POSSIBLE DEVELOPMENTS IN U.S. AND GLOBAL FISH MARKETS DUE TO EXTENDED JURISDICATION AND A PROPOSED RESEARCH AGENDA,
Synergy, Inc., Washington, DC.
T. Colvin, D. Zimmerman, and B. Hinds.
Marine Technology Society Journal, Vol 13, No 2, p 18-25, 1979. 6 Tab, 7 Ref.

Descriptors: *Marine fisheries, *Fish management, *Economic prediction, *200 mile economic zone, *Regulation, Regression analysis, Commercial fishing, Econometrics, Economic impact, Forecasting, Marketing, Fish harvest, Prices, Foreign trade, Model studies.

This report presents preliminary results of a study to determine whether additional research on economic models used to analyze the extended 200-mile fishing zone is needed. Econometric forecasting models are used to develop baseline forecasts of expected occurrances in U.S. fisheries under several extremely limiting assumptions. These forecasts are used to determine marginal impacts of new National Marine Fisheries Service initiatives and programs and allow for a zero-based budget. Results in the form of a set of simple reduced form market price functions show that real prices of most market categories increase. Four scenarios are presented for comparison. The first scenario assumes that all fish species caught off U.S. coasts by foreigners in 1974 will be caught by U.S. fishermen, in 1977 and supplied to both domestic and foreign markets; the second scenario assumes that the world supply of fish drops dramatically the third and fourth assume that landings will increase 2% and 5% each year due to successful management and rebuilding of stocks. Strange results were reported when these scenarios were analyzed. A sensitivity analysis of fish market models was run to correct the problem. Results of this show great disparities in changes of real prices for market categories. Additional research in fisheries market models is needed to: (1) obtain more realistic forecasts of what U.S. and foreign fishermen and governments are planning, and (2) refine the U.S. market supply and demand parameter estimates. (Luedtke-Wisconsin)
W80-02451

ENVIRONMENTAL FINANCING LITIGATION,
G. G. Minturn.
Natural Resources Journal, Vol 19, No 3, p 679-686, July 1979.

Descriptors: *Attorneys fees, *Litigation, *Federal Water Pollution Control Act, Citizen suits, Judicial decisions, Legal aspects, Save Our Sound Fisheries Association vs. Callaway, Natural Resources Defense Council vs Costle, Section 1365, FWPCA.

Environmental plaintiffs who use citizen-suit provisions of the Federal Water Pollution Control Act (FWPCA) may seek an award of attorneys fees provided they comply with strict jurisdictional requirements of Section 1365 of the Act. These requirements include giving 60 days notice to all parties before filing suit and confining the suit to certains violations by polluters or nondiscretionary omissions by the Administration of the Environmental Protection Agency. Meeting the requirements of Section 1365 is a major problem because they are much stricter than statutory provisions of other authorizing legislation. Even if these requirements are met, the court has wide discretion in determining who will receive an award. Defendants will not generally receive attorneys fees unless they can demonstrate they were victims of a harrassing or frivolous action. Plaintiffs must demonstrate that their action was in the public interest and that, it served the purpose intended by Congress in providing for citizen suits in the FWPCA. The cases of Save Our Sound Fisheries Association vs. Callaway and the Natural Resources Defense Council vs Costle are cited to demonstrate these criteria. (Luedtke-Wisconsin)
W80-02453

JOINT VENTURE IN FISHERIES BETWEEN DISTANT-WATER AND DEVELOPED COASTAL NATIONS: AN ECONOMIC VIEW,
Washington Univ., Seattle. Inst. of Marine Studies.
W. Kaczynski.
Ocean Management, Vol 15, No 1, p 39-48, 1979. 2 Tab, 6 Ref.

Descriptors: *Marine fisheries, *International cooperation, *Economic efficiency, *Jurisdiction, Joint ventures, International waters, 200-mile economic zone, Marketing, Fish harvest, Commercial fishing, Economics, Foreign trade, Costs, Benefits, Resources development.

Extension of national jurisdiction and a radical change in the pattern of access to the coastal fishery resources imply that international cooperation between developed coastal and foreign fishing countries offers the optimal way to exploit the resource. Joint exploitation is a way for distant-water fishing nations to partially neutralize harvesting limitations imposed on them as well as to produce additional income opportunities. With their increasing range of operations, these joint ventures also have provided land-based facilities for support services, including fish cargo handling ship repair; and crew recreational facilities. Japan currently has the most joint ventures with the U.S., supplying fish products to the Japanese consumption market. Many other distant-water fishing nations, including those in Eastern Europe, have begun to develop cooperative links with coastal nations in recent years in order to alleviate harvesting restrictions and increase employment opportunities for their fleets. Joint ventures benefit developed coastal nations by fostering exploitation of coastal resources during periods when these cannot be utilized by local fishermen. They are attractive to both sides if they produce additional volumes of fish and if they offer an economically more effective way of resource utilization. Development of lower market value species in nations such as the U.S., Canada, and Australia, offers considerable potential. (Luedtke-Wisconsin)
W80-02457

PUBLIC RECREATION ON VIRGINIA'S INLAND STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Virginia Water Resources Research Center.
W. E. Cox, and K. A. Argow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-131394, Price codes: A05 in paper copy, A01 in microfiche. Bulletin 120, October 1979. 93 p, 1 Fig, 2 Tab, Append, OWRT A-073-VA(1).

Descriptors: *Recreation, *Public rights, *Water law, *Virginia, *Streams, Public access, Riparian rights, Canoeing, Fishing, Navigability, Landowners' attitudes, Property rights.

Analysis of decisions of the Virginia court concerning the public right of navigation and the ownership of lands beneath the waters of streams allows tentative conclusions to be reached regarding public recreational rights. In general, streams suitable for commercial navigation have publicly owned beds and are open to public use. The public generally has no recreational right in streams not navigable by the commercial-use test unless reserved in state ownership by 1780 and 1802 Virginia statutes. Official navigability determinations have not been made for many of the state's streams with the result that uncertainty continues to exist in many individual cases. Part I of this report examines specific declarations of public recreational rights, the navigability issue, the streambed ownership issue, and other factors affecting public rights. Part II reports a survey of riparian landowners' perceptions regarding public recreational use of streams.
W80-02604

GROUND WATER STORAGE FOR CALIFORNIA WATER PROJECT,
California State Dept. of Water Resources, Los Angeles. Southern District.
For primary bibliographic entry see Field 4B.
W80-02663

6F. Nonstructural Alternatives

FLOOD-PLAIN MANAGEMENT: ADMINISTRATIVE PROBLEMS AND PUBLIC RESPONSES,
Kansas Water Resources Research Inst., Manhattan.
E. J. Baur, and J. M. Weller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-128895, Price codes: A04 in paper copy, A01 in microfiche. Contribution No 206, June 1979. 45 p, 60 Ref, 2 Append. OWRT A-081-KAN (1), 14-34-0001-7036.

Descriptors: *Flood plain management, *Flood plain insurance, *Flood plain zoning, Public participation, Medium sized cities, Kansas, Iowa, Missouri, Nebraska.

Important among nonstructural methods for reducing damage from flooding is the regulation of land use in flood plains combined with government sponsored insurance. The Flood Disaster Protection Act of 1973 provides for such a program to be adopted by local communities. Participation is induced by penalities and incentives. Nevertheless, not all communities have promptly qualified for full participation. A questionnaire survey of medium sized cities in Kansas, Missouri, Iowa and Nebraska found that nearly all of them were complying with the law and if not fully participating, were taking appropriate steps to do so. Many of the latter were appealing flood-hazard zone boundaries or were making appropriate structural changes to reduce the size of area vulnerable to flooding or its frequency so as to reduce the need for insurance or its cost. Though many participants in the program were critical, they felt constrained by the coercive provisions of the law. The few that did not want to participate either did not believe that they were vulnerable to flooding, or that they could eliminate the problem by structural changes.

The influence of public opinion and pressure groups did not figure significantly in local decisions. Where there was not apathy, there was more support for participation than opposition. (Baur-Weller--Kansas)
W80-02473

6G. Ecologic Impact Of Water Development

STUDIES ON THE INFLUENCE OF MAN (ANGLING) ON FRESHWATER FISH POPULATIONS IN SOUTHERN POLAND,
Polish Academy of Sciences, Krakow. Inst. of Biology.
J. M. Wlodek.
In: Proceedings: Congress in Denmark, 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 20, Part 4, 1978, p 2142-2145. 2 Tab, 8 Ref.

Descriptors: *Biomass, *Fish populations, *Poland, *Environmental effects, *Sport fishing, *Fisheries, *Recreation demand, Rivers, Fish, Population, Fishing, Recreation, Freshwater fish, Sport fish, Brown trout, Fisheries, Fish management, Mountains, Public lands.

Comparing highest observed fish biomass in three Polish drainage basins and zones in 1966-1974 to corresponding averages shows that average biomass is 75% smaller than the highest observed; 50% of the fish are caught, and most of the others are killed by other human activities. Indiscriminate angling therefore, is harmful to fish stocks, especially sport fish. Four distinct fish zones were observed: (1) high mountain, (2) mountain, (3) submontane, and (4) upper lowland. Fish biomass in a reservation where fishing is forbidden, is compared with adjacent areas where it is permitted to estimate angling pressure. In zone A adjacent to the reservation, 42.9% fish biomass is removed by anglers. Zone B angling occurs are higher than zone A: 69.7% of fish removed is by angalers. Impacts occur only with brown trout (Salmo trutta), a sport fish; in zone A 56% biomass is removed, in zone B 90% biomass is removed. Large biomass decreases in zone B are due to angling pressure: a good road exists for easy angling accessibility and the river flows through the village. East thumb (Cottus poecilopus) is not a sport fish and therefore is does not only preserve its biomass in zone A but increases it by 15%. In adjacent zone B, it decreases 63.7%; this is probably because zone B is not its natural habitat. East thumb biomass decline is propbably due to environmental rather than angling influences. (Danovich-Wisconsin).
W80-02487

EXPLOITATION OF FISHERY RESOURCES IN LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
P. Biro.
In: Proceedings: Congress in Denmark 1977, Internationale Vereinigung fur Theoretische und Angewandte Limnologie; Vol 20, Part 4, 1978, p 2146-2149. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Lake Balaton, Hungary, *Exploitation, *Fish populations, *Commercial fishing, *Fisheries, Fish, Pikeperch, Bream, Asp, Mortality, Fishing, Eutrophication, Yield equations, Fish reproduction, Biomass, Dynamic programming, Population, Fish management, Density, Eutrophication.

Changes in pikeperch (Stizostedion lucioperca), bream (Abramis brama) and asp (Aspius aspius) populations in Lake Balaton (596 sq km) Hungary, are analyzed in relation to biotic and abiotic effects and commerical fishery exploitation. Average biomass is 9.7 kg/ha (pikeperch), 1607 kg/ha (bream), and 0.37 kg/ha (asp). Species differ greatly in population density as well as production, mortality, survival, and exploitation rates. Average annual biomass mortality loss is 375.7 MT pikeperch (65%), 59,385.5 MT bream (62%), and 10.4 MT asp (48%). Commerical fisheries remove 30%, 10.5% and 55.5% of average biomass, respectively. Other fish biomass reduction is due to sport fishing and natural mortality. Dynamic pool models show that estimated equilibrium yield-per recruits in various age groups plotted against fishing intensity vary according to fishable life-span, production, and population size and growth, as well as mortality rates. Yield-isopleths indicate heavy or slight overfishing of present populations. Due to fish kills in 1965 and 1975, the stock deteriorated. Compared to other European waters, pikeperch growth is slow, larvae and fry mortality is high, and biomass per unit area is low. Recruitment is insufficient to balance population losses. Management approaches to rectify negative cultural eutrophication effects should include measure which do not deplete primary producers. (Danovich-Wisconsin)
W80-02488

7. RESOURCES DATA

7A. Network Design

DESIGN OF A NETWORK FOR MONITORING GROUND-WATER QUALITY IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
M. F. Hult.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price codes: $18.00 in paper copy, $6.50 in microfiche. Geological Survey open-file report 79-1164, 1979. 44 p, 13 Fig, 1 Plate, 4 Tab, 8 Ref.

Descriptors: *Network design, *Groundwater, *Water quality, *Monitoring, *Minnesota, Water wells, Aquifers, Water analysis, Baseline studies, Sampling, Chemical analysis, Maps, Sites.

A network for monitoring the quality of water in the 13 principal aquifers in Minnesota has been designed and more than 400 wells and springs selected for sampling. The network organization includes four major elements; (1) point sampling, (2) point monitoring, (3) regional monitoring, and (4) site-specific monitoring. These elements constitute monitoring strategies designed to define baseline conditions and monitor major time-and-space trends of more than 60 water-quality parameters. (Woodard-USGS)
W80-02588

7B. Data Acquisition

DIRECTORY OF WATER RESOURCES EXPERTISE.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-127616, Price codes: A05 in paper copy, A01 in microfiche. California Water Resources Center, California University, Davis. Revised Edition, June 1979, 92 p. OWRT A-999-CAL(14).

Descriptors: *Scientific personnel, *Professional personnel, Research and development, Comprehensive planning, Project planning, California, *University of California, Directory.

This publication was compiled to fill a need for the identification of persons working in water resources research on the several campuses of the University for the benefit of those with the University of California as well as individuals, governmental agency personnel, and business and industrial personnel. The primary purpose is to facilitate contact between those desiring information in a specific area and those able to provide such information. (Snyder-California)
W80-02411

MERCURY-IN-GLASS THERMOMETERS FOR PRECISE TEMPERATURE MEASUREMENTS NEAR O C,
Alaska Univ., Faribanks. Geophysical Inst.
For primary bibliographic entry see Field 2C.
W80-02483

A SYSTEM FOR ACCURATE TEMPERATURE CONTROL OF SMALL FLUID BATHS,
Department of Science, Melbourne (Australia). Antarctic Div.
For primary bibliographic entry see Field 2C.
W80-02484

AN INVESTIGATION OF SURFACE ALBEDO VARIATIONS DURING THE RECENT SAHEL DROUGHT,
Wisconsin Univ., Madison. Space Science and Engineering.
C. C. Norton, F. R. Mosher, and B. Hinton.
Jounal of Applied Meteorology, Vol 18, No 10, p 1252-1262, October 1979. 19 Fig, 2 Tab, 25 Ref. NASA NGR50-002-215.

Descriptors: *Albedo, *Droughts, *Deserts, *Remote sensing, Satellites(Artificial), Precipitation(Atmospheric), Rainfall, Arid climates, Arid lands, Numerical analysis, Mathematical models, Data processing, Reflectance, Climatology, Meteorology, *Sahel(Africa), *Sahara(Africa).

Applications Technology Satellite 3 green sensor data were used to measure surface reflectance variations in the Sahara/Sahel during the recent drought period 1967-74. The magnitude of the seasonal reflectance change was shown to be as much as 80% for years of normal precipitation and less than 50% for drought years. Year-to-year comparisons during both wet and dry seasons revealed the existence of a surface reflectance cycle coincident with the drought intensity. The relationship between the green reflectance and solar albedo was examined and estimated to be about 0.6 times the reflectance change observed by the green channel. (Sims-ISWS)
W80-02497

MEASUREMENT OF CONVECTIVE MEAN RAINFALL OVER SMALL AREAS USING HIGH-DENSITY RAINGAGES AND RADAR,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 2B.
W80-02530

METHODS FOR DETERMINATION OF INORGANIC SUBSTANCES IN WATER AND FLUVIAL SEDIMENTS.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from Supt. of Documents, GPO Washington, DC 20402. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A1, 1979. 626 p, 70 Fig, 5 Tab, 10 Ref, M. W. Skougstad, M. J. Fishman, L. C. Friedman, D. E. Erdmann, S. S. Duncan, Eds.

Descriptors: *Chemical analysis, *Inorganic compounds, *Sediments, *Water analysis, *Analytical techniques, Testing procedures, On-site tests, Laboratory tests, Laboratory equipment, Instrumentation, *Methods manual.

This manual contains more than 200 detailed analytical procedures used by the U.S. Geological Survey for the quantitative determination of 69 different inorganic constituents and properties of water and bottom material, including all the major constituents, such as calcium, sodium, alkalinity or acidity, chloride, sulfate, and nitrogen and phosphorus compounds, and a great many of the common minor constituents, including iron, manganese, aluminum, boron, copper, zinc, cadmium, lead, mercury, and others. Included are methods based on atomic absorption spectrometric, colorimetric, electrometric, gravimetric, and titrimetric techniques; many automated chemical analytical methods are given. Each method is described in detail including application, principle, interferences, apparatus and reagents required, step-by-step procedure, computations and reporting results, and precision of the method when such data are available. Methods are given for determining dissolved, total recoverable, and total concentrations of constituents in water samples, and recoverable and total concentrations of constituents in bottom material. Essential definitions are given in

the introduction. Quality control in the water-analysis laboratory is discussed, including accuracy and precision factors, the use of standard reference water samples, and the operation of an effective quality assurance program. (Woodard-USGS)
W80-02596

TRACE METAL ION FILTRATION LOSSES AT PH 5 AND 7,
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W80-02600

A RAPID ANALYSIS OF SURFACE WATERS BY HIGH PRESSURE LIQUID CHROMATOGRAPHY,
Wisconsin Univ.-Madison. Dept. of Soil Science.
K. Huibregtse.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-132681, Price codes: A08 in paper copy, A01 in microfiche. M.S. Thesis, 1979. 150 p, 23 Fig, 20 Tab, 86 Ref. OWRT A-069-WIS(1), 14-34-0001-6052.

Descriptors: *Chromatography, *Chemical analysis, Instrumentation, Water quality control, Water pollution, Water analysis, Water pollution sources, Industrial wastes, Municipal wastes, *Organic wastes, Pulp wastes, *High pressure liquid chromatography, High performance liquid chromatography, Reversed phase chromatography, Pollutant enrichment.

A simple rapid method for obtaining fingerprint traces of nonpolar organic contaminants in water samples by trace enrichment and high pressure liquid chromatography (HPLC) has been evolved. Samples of 30-1000 ml of river water were filtered through precolumns of a reversed-phase packing, Poracil C18. The precolumn was coupled to a high efficiency analytical column of micro-Bondapak C18 and the organic components eluted by solvent-gradient HPLC. Alternatively samples containing sediment were filtered through Sep-Paks (teflon cartridges of Poracil C18) coupled with end filters to remove the sediments. The organics were extracted from the Sep-Paks with methanol and chromatographed. Chromatograms of samples taken above, at, or below the outfalls of industrial plants, sewage treatment facilities, and other point sources of pollution clearly revealed differences in water fingerprints which indicated the extent and persistence downstream of organic contaminants. The method is suitable for rapid routine screening of water quality to help pinpoint unknown sources of organic pollutants. (Harkin-Wisconsin)
W80-02603

ELECTRIC LOGS...JUST FOR WATER WELLS,
E. C. Munson.
Pacific Ground Water Digest, Vol 2, No 11, p 18-21, November, 1979.

Descriptors: *Electrical well logging, *Water wells, Radioactive well logging, Resistivity, Borehole, Electric currents, Drillers logs, Costs, Borehole geophysics, History.

The development and use of various types of electric logging techniques is reviewed. Economics was still is an important factor in the development of the well logging industry. Recently, the use of electric logs in the water well industry has become economical due to the increased cost of water wells and difficulty in locating usable ground water in new areas. The cost of logging is usually less than 3% of the total cost of the average water well. The point resistivity log measures resistance of an electric current passing through earth material. Numerous corrections are required to obtain a true resistivity value due to borehole effects. The lateral electric and micro electric log were developed for more accurate readings. The spontaneous potential log measures very small natural currents found in the borehole. Beside electric logs, there are gamma logs which measure the natural radiation present in the borehole, caliper logs to measure the hole diameter, temperature sensors, and salinometers. Electric logs will aid in selecting the best water producing zone and in correcting problems that may develop with the casing. (Purdin-NWWA)
W80-02650

RESIN ADSORBENT TAKES ON CHLORORGANICS FROM WELL WATER,
Rohm and Haas Co., Spring House, PA. Research Div. Labs.
For primary bibliographic entry see Field 5F.
W80-02654

A DIGITAL RECORDING SYSTEM FOR TIPPING BUCKET RAINGAGES: DESCRIPTION AND FIELD TESTING,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
For primary bibliographic entry see Field 2B.
W80-02680

PATTERN RECOGNITION ANALYSIS OF SNOWDRIFTS,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2C.
W80-02688

A COMPARISON OF SOME METHODS FOR ESTIMATION OF POTENTIAL EVAPORATION,
Royal Veterinary and Agricultural Coll. Copenhagen (Denmark). Hydrotechnical Lab.
For primary bibliographic entry see Field 2D.
W80-02689

7C. Evaluation, Processing and Publication

MAPS SHOWING GROUND-WATER CONDITIONS IN THE KANAB AREA, COCONINO AND MOHAVE COUNTIES, ARIZONA--1976,
Geological survey, Tucson, AZ. Water Resources Div.
G. W. Levings, and C. D. Farrar.
Geological Survey open-file report 79-1070 (WRI), June 1979. 2 Sheets, 9 Ref.

Descriptors: *Groundwater, *Mapping, *Aquifer characteristics, *Water table, *Water quality, Hydrogeology, Subsurface mapping, Water yield, Irrigation, Water wells, Water analysis, Specific conductivity, Fluorides, Arizona, *Kanab area(AZ), *Coconino County(AZ), *Mohave County(AZ).

The Kanab area includes about 3,500 square miles in northwestern Arizona. Ground water is obtained from several aquifers that are made up of one or more formations. The aquifers overlie one another and generally are not hydraulically connected because of intervening impermeable beds. The formations that yield water to wells and springs are the alluvium; basalt; N aquifer, which consists of the Navajo Sandstone, Kayenta Formation, and Moenave Formation; Shinarump Member of the Chinle formation; Moenkopi Formation; Kaibab Limestone; Toroweap Formation; Supai Group; and Muav Limestone. Although several of the aquifer underlie most of the Kanab area, they are dry in places. Ground-water development has been slight, and in 1976 the estimated pumpage was slightly more than 2,000 acre-feet, most of which was used for irrigation in the Short-Cane Beds area. Information shown on the maps, scale 1:125,000, includes the principal aquifer that furnishes water to wells and springs, depth to water, altitude of the water level, specfic conductance, and fluoride concentration. (Woodard-USGS)
W80-02589

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1978--VOLUME 2. DELAWARE RIVER BASIN AND TRIBUTARIES TO DELAWARE BAY,
Geological Survey, Trenton, NJ. Water Resurces Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-116536, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NJ-78-2, June 1979. 302 p, 14 Fig, 5 Tab, 36 Ref.

Descriptors: *New Jersey, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Delaware River Basin(NJ), Delaware Bay tributaries(NJ).

Water resources data for the 1978 water year for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume includes the Delaware River basin and tributaries to Delaware Bay and contains discharge records for 22 gaging stations: tide summaries for 4 stations; stage and contents for 16 lakes and reservoirs; water quality for 17 gaging stations, 80 partial-record flow stations, and 51 wells; and water levels for 8 observation wells. Also included are 27 crest-stage partial-record stations and 19 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by U.S. Geological Survey and cooperating State and Federal agencies in New Jersey. (Woodard-USGS)
W80-02598

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1978.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-122344, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OR-78-1, June 1979. 650 p, 5 Fig, 1 Tab.

Descriptors: *Oregon, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 278 gaging stations, stage only records for 10 gaging stations, stage and contents for 44 lakes and reservoirs, water quality for 85 gaging stations, and water levels for 95 observation wells. Also included are 91 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (Woodard-USGS)
W80-02599

DISPERSION MODELING IN TIME AND TWO DIMENSIONS,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
J. F. Henry, and E. G. Foree.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 105, No EE6, p 1131-1147, December, 1979. 11 Fig, 9 Ref, 1 Append.

Descriptors: *Mathematical models, *Dispersion, Water pollution, Environmental effects, Coal, Waste disposal wells, Injection wells.

A two-dimensional dispersion model for predicting pollutant spread and resultant impacts is described. This model approximates complicated mathematical expressions to derive an equation for disper-

sion profiles which can be quickly solved arithmetically on a hand-held calculator. Three uses of the model in environmental impact studies are described. These are: (1) determining the extent of ground water pollution from an underground coal gasification operation; (2) estimating the spread of wastes injected into a deep well; and calculating the extent of vinyl chloride atmospheric emissions from a polyvinyl chloride plant. Since the utility of the model has not been fully investigated, it should be used for preliminary environmental impact calculations rather than as the basis for definitive engineering design work. (Purdin-NWWA)
W80-02664

REAL-TIME ESTIMATION OF VELOCITY AND COVARIANCE STRUCTURE OF RAINFALL EVENTS USING TELEMETERED RAINGAGE DATA--A COMPARISON OF METHODS,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 2B.
W80-02678

SPATIAL CORRELATIONS OF PRECIPITATION IN NORTHWEST GEORGIA,
Oak Ridge National Lab., TN. Engineering Technology Div.
For primary bibliographic entry see Field 2B.
W80-02698

8. ENGINEERING WORKS

8A. Structures

UNDERWATER TERRAIN REINFORCEMENT MATTING,
Akzona, Inc., Asheville, NC. (Assignee).
J. G. Vos, B. H. Daimler, W. Herveling, A. Birker, and S. Langefeld.
U.S. Patent No 4,168,335, 5 p, 8 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 986, No 3, p 689, September 18, 1979.

Descriptors: *Patents, *Erosion control, *Channel erosion, Underwater, Materials, Matting, Nonwoven matting.

A matting is disclosed for reinforcing underwater terrains. The matting is made of sections of looped intersecting synthetic polymer filaments bonded to one another at their points of intersection, at least one section being temporarily buoyant in water. The matting may be towed into position and then submerged. The advantage of such a matting lies in its open, low density structure. The structure allows sand, plant growth and other particles to become easily entrapped within the matting. The entrapped particles act as effective anchors for the matting and allows the matting to effectively blend into the underwater landscape. (Sinha - OEIS)
W80-02618

WATER INTAKE DEVICE,
W. L. Dovel.
U.S. Patent No 4,169,792, 6 p, 5 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 987, No 1, p 169-170, October 2, 1979.

Descriptors: *Patents, *Industrial water, *Cooling water, *Intakes, Fish barriers, Filtration, Screens, Intakes structures, Backwashing.

A water intake device for supplying water for use in the operation of power plants and other installations which require a large volume of water is described. To prevent screen clogging and/or fish kill, various techniques and screens are used to prevent the fish from entering the cooling water intake. In this invention a water intake device comprises a movable screen, such as a cylindrical rotatable screen, adapted to be partially submerged in a body of water. As the water flows through the screen, backwashing such as jets of water, direct water at a segment of the screen as that section moves. The jets of water serve to clear and/or remove objects or fish caught on the outside of the screen. Duct means are also provided for a flow channel for the objects or fish removed from the screen. The duct means are dimensioned and positioned so as to carry objects or fish beyond the pull or suction of the water entering the screen. (Sinha-OEIS)
W80-02631

DAM WITH SUSPENDED HYDROELECTRIC STATION,
F. J. G. Atencio.
U.S. Patent No 4,170,428, 6 p, 4 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 390, October 9, 1979.

Descriptors: *Patents, *Engineering structures, *Dams, *Dam design, Water storage, Pumped storage, Hydroelectric plants, Buoyancy.

The invention relates generally to dams having hydroelectric stations erected in river watersheds for the purpose of energy generation-transformation, navigation development, flood control and the provision of good water storage for flood control. It is intended to include reversible pumped-storage electric power systems. A dam body of considerable less mass is required due to the suspended feature of the associated hydromotive assembly and the introduction of the substantially horizontal-axis engineering concept. The hydromotive assembly includes integral buoyancy means for maintaining it in a suspended operable position. A further reduction in construction cost may be realized by incorporating a diffuser downstream of each water passage as an integral part of the dam body. (Sinha-OEIS)
W80-02634

FIBERGLASS CASING USED IN CORROSIVE GEOTHERMAL WELLS,
Campagnie Francaise des Petroles, Paris (France).
P. J. Angles.
Oil & Gas Journal, Vol 77, No 42. p 131-132, October 15, 1979. 2 Tab.

Descriptors: *Geothermal studies, *Well casing, *Plastic pipes, Cement grouting, Drilling, Injection wells, Corrosion.

Fiberglass reinforced epoxy pipe was used as production and injection casing for a geothermal district heating project near Paris, France. It has similar thread design and mechanical properties as steel casing and greater corrosion resistance and cement adherence. No problems were encountered during installation of the casing in a 25 degree deviated well and results have been satisfactory. This type of casing is presently limited to depths of 2,000 m (6600 ft). However, new design and fabrication techniques will enable this pipe to be used in deeper deviated wells. Cement-lined casing was rejected in favor of fiberglass casing due to uncertainty of continuous lining, turbulent effect on lining at joints, and possible damage to lining at joints, and possible damage to lining during handling and operation. (Purdin-NWWA)
W80-02652

SAFETY AT THE DRILL SITE OF CONCERN TO DRILLERS,
A. Hewitson.
Canadian Water Well, Vol 5, No 4, p 12-13, November, 1979.

Descriptors: *Safety, *Hazards, *Drilling, Electrical equipment, Explosions, Natural gas, Accident.

Water well drilling has a better record of accident frequency than general construction. The most common hazards faced by well drillers are electrical shock from contacting overhead wires or electrical equipment, explosions of gas cylinders, and natural gas pockets. To avoid accidents, drilling rigs should be kept far enough from live power lines, preventive maintenance programs should include regular testing of all power tools, and explosion-proof shelters and portable vent fans should be used. (Purdin-NWWA)
W80-02653

PRIMITIVE WELL DRILLING TECHNIQUES: PART II,
National Water Well Association, Worthington, OH.
T. E. Gass.
Water Well Journal, Vol 33, No 11, p 34-35, October, 1979. 2 Fig.

Descriptors: *Roary drilling, *History, *Technology, Earth augers, Drilling fluids.

The development of rotary drilling technology is discussed from a historical veiwpoint. Early rotary drilling consisted of either 'pod' or helical earth augers depending on soil type. They were capable of drilling deep wells but were inefficient until the mid 1840's when fluid circulation was used to flush cuttings from the hole. Another improvement occurred around 1890 with the invention of the rotary table. (Purdin-NWWA)
W80-02656

COLLAPSE PRESSURE OF THERMOPLASTIC WATER WELL CASINGS,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W80-02659

NEW RIG DRILL AND SET CASING SIMULTANEOUSLY,
For primary bibliographic entry see Field 8C.
W80-02660

GEOTHERMAL: AN IDEA WHOSE TIME HAS COME...,
Pacific Ground Water Digest, Vol 2, No 11, p 43-44, November, 1979.

Descriptors: *Geothermal studies, *Wood wastes, *Power plants, Feasibility studies, California, Greenhouses.

The U.S. Department of Energy has begun funding of feasibility studies of a unique hybrid power plant located near Susanville, California. It would be the first to combine low temperature geothermal energy with a wood waste burner to provide steam for a 55 MW power plant. In addition, geothermal effluent at approximately 100F will heat 200 greenhouses at the site. If proved feasible, the project could be in operation by 1985. If successful, similar power plants will be established in the western states where low temperature geothermal resources often coincide with forest areas. (Purdin-NWWA)
W80-02662

HOW GEOTHERMAL WELLS ARE COMPLETED AND PRODUCED,
Completion Technology Co., Houston, TX.
R. E. Synder.
World Oil, Vol 189, No 5, p 81-87, October, 1979. 14 Ref.

Descriptors: *Geothermal studies, *Well casings, *Wells, *Cement grouting, Injection wells, Corrosion, Scaling, Failure(Mechanics), Damages.

The state of the art technology, recognized problems and limitations relevant to completion and production of geothermal wells are examined. Typical geothermal wells produce low pressure steam or hot brine from shallow (5000-9000 feet) depths but effects of high temperatue and 100% aqueous environment create unique problems with casing and serious primary cementing limitations. Possible causes of casing failure in geothermal wells include formation loading, mechanical damage, corrosion and scaling, thermal stress, metal failure, and entrapped fluid expansion. To avoid these problems casing should be constructed of moderate strength steels of the correct weight and grade and joined together with API Buttress type couplings. Lost circulation and crossflow, excessive mud gellation and staging tool failures contribute to inefficient and/or incomplete placement of cement even with modern high-temperature cements. The use of uncemented, slotted liners over long productive intervals is an economic al-

ternative to expensive and difficult cementing and perforating. However, this may result in long range sand pumping problems. (Purdin-NWWA)
W80-02665

TESTS SHOW METHODS FOR IMPROVED GRAVEL PACKING,
Chevron Oil Field Research Co., La Habra, CA.
S. G. Shryock.
World Oil, Vol 188, No 2, p 55-58, August 1, 1979. 5 Fig, 2 Tab.

Descriptors: *Gravels, *Well filters, *Physical models, Particle size, Well screens, Erosion control, Compaction, Packed beds, Porosity, Soil density, Mixing, Turbulence.

Gravel packs are used to prevent sand production in wells completed in unconsolidated formations. Gravel packing mechanics were studied in a full-scale transparent well bore model. This helped determine the effects of six parameters on the placement and performance of gravel pack completion. These are: gravel quality, slot sizing, crossover port damage, carrier fluids, pack washing problems, and grvael compaction. Undersized particles and fines reduce flow capacity of both gravel and screen. Slot width should be equal to or less than the samllest grain diameter of the gravel. Shattering of gravel at the crossover port and resulting fines production was reduced by increasing the diameter of the crossover port from 1 to 1.5 inches to decrease the exit velocity. Viscous carrier fluids eliminate fines buildup from recirculation, can transport higher concentration without erosion and support the open hole to prevent sloughing during completion operations. Turbulent washing does not settle the gravel pack and may introduce formation sand into it. The tighter the gravel can be placed, the better the pack will perform in controlling sand production. (Purdin-NWWA)
W80-02666

ENERGY-DISSIPATING BYPASS FOR HYDROELECTRIC POWERHOUSE,
Westinghouse Electric Corp., Sunnyvale, CA.
For primary bibliographic entry see Field 8B.
W80-02697

8B. Hydraulics

MINING EARTH'S HEAT: HOT DRY ROCK GEOTHERMAL ENERGY,
Los Alamos Scientific Lab., NM.
For primary bibliographic entry see Field 8E.
W80-02651

PRIMITIVE WELL DRILLING TECHNIQUES: PART II,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 8A.
W80-02656

TESTS SHOW METHODS FOR IMPROVED GRAVEL PACKING,
Chevron Oil Field Research Co., La Habra, CA.
For primary bibliographic entry see Field 8A.
W80-02666

TURBULENT JETS IN CO-FLOWING STREAMS,
Alberta Univ., Edmonton, Dept. of Civil Engineering.
P. B. B. Lal, and N. Rajaratnam.
Journal of the Engineering Mechanics Division, American Society of Civil Engineers, Vol 105, No EM6, Proceedings Paper 15043, p 1025-1038, December 1979. 6 Fig, 15 Ref, 3 Append.

Descriptors: *Jets, *Momentum equation, *Turbulent flow, *Continuity equation, Velocity, Turbulence, Fluid mechanics, Analysis, Profiles, *Submerged jets, Similarity, Velocity profiles.

This paper presented a method for prediciting the variation of the velocity and length scales for plane and circular turbulent jets issuing into co-flowing streams. The basis of this method is an assumed variation in the turbulence production integral in the transition region from the strong jet to the weak jet. The solution is built around the integral momentum and energy equations. The predictions from this method agree well with the experimenal results for both plane and circular jets. (Adams-ISWS)
W80-02691

MASS TRANSFER VERIFICATIONS OF TIDAL FROUDE MODELS,
Old Domnion Univ., Norfolk, VA.
For primary bibliographic entry see Field 2L.
W80-02695

ENERGY-DISSIPATING BYPASS FOR HYDROELECTRIC POWERHOUSE,
Westinghouse Electric Corp., Sunnyvale, CA.
E. F. Goedde, V. G. Guins, and R. P. Strumpf.
Journal of the Hydraulic Division, American Society of Civil Engineers, Vol 105, No HY12, Proceedings Paper 15070, p 1487-1499, December 1979. 7 Fig, 2 Tab, 2 Ref, 1 Append.

Descriptors: *Aeration, *Hydroelectric power, *Energy dissipation, Cavitation, Energy, Valves, Hydraulic jump, Bypasses, Hydroelectric plants, Jets, Baffles, *Absorbers, Bypass valves, Needle valves, Regulators, Relief valves.

A hydraulic energy-dissipating bypass system for continuous flow operation in a hydro-electric power plant was described. Difficulties with cavitation, flow separation, vibration, and mechanical failure are encountered in many existing bypass systems. These difficulties increase with the pressure head. This paper described the design principles and features of a high-head bypass system that successfully eliminates these difficulties and discharges a steady, uniform, low velocity flow at its outlet. The bypass system consists of a needle valve, an air entrainment system or energy-absorber cone, and a energy-absorbing stilling chamber with attached outlet duct. Modifications to the system were described, including the installation of baffle blocks in the outlet duct. Full-scale tests verifying system performance by pressure and flow velocity measurements were described. (Lee-ISWS)
W80-02697

8C. Hydraulic Machinery

WATER DISTRIBUTION CHAMBER FOR AN ELECTRIC STEAM GENERATOR,
CAM Industries Inc., Kent, WA. (Assignee).
R. N. Coates.
U.S. Patent No 4,169,558, 6 p, 6 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 987, No 1, p 97, October 2, 1979.

Descriptors: *Patents, *Water control, *Industrial water, Flow control, Waves(Water), Fluctuations, Baffles, Boilers, Steam, Steam generators.

Horizontal damping elements are arranged in the water distribution chamber to damp out wave action in the water flowing to the individual compartments formed by vertical baffles. The damping elements may be integral with the baffles to form one-piece members or may be formed of flat plates separate from the baffles. The dampening elements prevent periodic fluctuations from occurring in the water streams from which steam is produced and thus fluctuations in the amounts of generated steam. (Sinha-OEIS)
W80-02628

DREDGE WITH ROTATABLE CUTTER DISCS,
M. L. Holekamp.
U.S. Patent No 4,170,079, 11 p, 14 Fig, 25 Ref; Official Gazette of the United States Patent Office, Vol 987, No 2, p 272, October 9, 1979.

Descriptors: *Patents, *Dredging, *Hydraulic equipment, Channel improvement, Excavation, Boats, Pontoons.

In a vessel-mounted dreding device material freed by revolving cutters is pumped through a suction mouth and discharge pipe to a place remote from the cutters. A platform, upon which a pump is mounted, and beneath which cutter discs are mounted, is itself mounted to the lower end of a mast. The mast arranged for movement vertically with respect to a vessel is mounted upon the bow. The vessel is made with main pontoons running fore and aft, spaced from one another about the center line of the vessel a distance sufficient to accommodate a discharge pipe. One end is connected to the discharge side of the pump, and the other end is cradled on rollers, permitting lengthwise translation of the discharge pipe as the pump is moved up and down by the mast. The cutter discs are equipped with trapezoidal teeth oriented generally parallel to the axis of rotation of the discs, and pivotally mounted on the discs on pivot axes parallel to the axis of rotation of the disc, in such a way that the teeth can swing to either side of a radius. In the preferred embodiment, two cutting discs are provided, with axes of rotation aligned in the fore and aft direction with respect to the vessel. The cutter discs lie in the same plane and are spaced from one another below a suction inlet of the pump. The cutter discs are rotated by hydraulic motors. (Sinha-OEIS)
W80-02632

THE GROUND-WATER GEOTHERMAL HEAT PUMP: AN IDEA WHOSE TIME HAS COME,
National Water Well Association, Worthington, OH.
J. H. Lehr.
Ground Water, Vol 17, No 6, p 522-523, November-December, 1979.

Descriptors: *Heat pumps, *Water districts, *Rural areas, Heating, Ground water, Geothermal studies, Water yield, Water wells.

Ground-water heat pumps have the potential of saving 25 million barrels of oil per year if they are installed in one million rural and suburban homes that already have a water supply well. Since annual energy savings from ground-water heat pumps average $600 to $800, the $1200 to $1500 initial investment for a recharge well can be repaid within two years. The controversy over unnecessary rural water districts (RWD) will now include the advantages of ground-water heat pumps. Few RWD's can be designed to economically supply enough water to fuel the ground water heat pump, while individual wells with a yield as low as two gpm would be adequate. (Purdin-NWWA)
W80-02649

NEW RIG DRILL AND SET CASING SIMULTANEOUSLY,
Canadian Water Well, Vol 5, No 4, p 17, November, 1979.

Descriptors: *Rotary drilling, *Well casing, *Drilling equipment, Hydraulic equipment, Hoisting machinery.

The Barber Dual 12-24 rotary drilling rig is capable of setting casing while drilling. The top rotary drive is lifted and swings sideways to lift drill pipe or casing while the lower rotary drive continues drilling. The casing is rotated as it is being set, eliminating the need for a casing driver. The rig also has the advantage of a completely hydraulic hoisting system which greatly improves operator safety and reduced maintenance cost and downtime. (Purdin-NWWA)
W80-02660

8D. Soil Mechanics

COLLAPSE PRESSURE OF THERMOPLASTIC WATER WELL CASINGS,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W80-02659

8E. Rock Mechanics and Geology

MINING EARTH'S HEAT: HOT DRY ROCK GEOTHERMAL ENERGY,
Los Alamos Scientific Lab., NM.
R. G. Cummings, G. E. Morris, J. W. Tester, and R. L. Bivins.
Technology Review, p 58-78, February, 1979. 18 Fig, 33 Ref.

Descriptors: *Geothermal studies, *Rocks, Electric power, Economic feasibility, Fractures, Injection wells, Cooling, Optimization.

The potential geothermal resource base of hot dry rock (HDR) reservoirs is estimated to be 13 million quads. However, only 0.2% is technically recoverable. HDR reservoirs with low permeabilities required the formation of fracture zones through hydraulic fracturing, injection of cool water and recovery of heated water. In formations with hgih permeabilities, water drive and flooding methods should be used to minimize fluid loss. The thermal drawdown or cooling rate for a fractured, low permeability HDR reservoir depends on the accessible fracture surface area, mass flow rate, fluid distribution, and density, heat capacity, and thermal conductivity of the rock. Optimization of the resource would minimize the thermal drawdown while maximizing the mass flow rate. The operation of an HDR system should have minimum enviornmental impact. However. exerimental and economic research is required before a definitive assessment of the commercial feasibility of HDR-produced electricity can be made. (Purdin-NWWA)
W80-02651

8F. Concrete

HOW GEOTHERMAL WELLS ARE COMPLETED AND PRODUCED,
Completion Technology Co., Houston, TX.
For primary bibliographic entry see Field 8A.
W80-02665

8G. Materials

UNDERWATER TERRAIN REINFORCEMENT MATTING,
Akzona, Inc., Asheville, NC. (Assignee).
For primary bibliographic entry see Field 8A.
W80-02618

FIBERGLASS CASING USED IN CORROSIVE GEOTHERMAL WELLS,
Campagnie Francaise des Petroles, Paris (France).
For primary bibliographic entry see Field 8A.
W80-02652

COLLAPSE PRESSURE OF THERMOPLASTIC WATER WELL CASINGS,
Auburn Univ., AL. Dept. of Civil Engineering.
C. E. Kurt.
Ground Water, Vol 17, No 6, p 550-555, November-December, 1979. 8 Fig, 9 Ref.

Descriptors: *Well casings, *Plastic pipes, *Collapse, Standards, Loads, Pressure, Soil strength, Equations, Buckling, Soil pressure.

The collapse pressure resistance of thermoplastic water well casing will increase due to the support of surrounding material. The equilibrium equations of Morley for uniform and linearly varying radial collapse pressure loading conditions were modified to include the effects of soil support and were solved using the Galerkin method. Simple formulas are proposed for predicting collapse for the two loading conditions considered. Collapse pressures predicted by the proposed formula for uniform collapse pressure are approximately 25% lower than those values predicted by the current collapse formula given in ASTM Standard F480. Collapse pressures for linearly varying pressure were 12% higher than the corresponding values for uniform pressure. Other factors that may affect actual collapse pressures are: uniformity of wall thickness, out-of-roundness, rate of loading, and heat of hydration during grouting. (Purdin-NWWA)
W80-02659

HOW GEOTHERMAL WELLS ARE COMPLETED AND PRODUCED,
Completion Technology Co., Houston, TX.
For primary bibliographic entry see Field 8A.
W80-02665

8H. Rapid Excavation

GROUND WATER CONTROL TO THE RESCUE: TWO CASE HISTORIES,
Golder Associates, Mississauga (Ontario).
J. L. Seychuk, and L. R. Lahti.
Canadian Geotechnical Journal, Vol 16, No 4, p 716-733, December, 1979. 25 Fig, 1 Tab, 2 Ref.

Descriptors: *Dewatering, *Excavation, *Seepage conrol, Drainage wells, Water levels, Tunnel construction, Shafts(Excavations), Subsurface investigations, Cofferdams, Well points.

Two case histories of dewatering during excavation are discussed. The first case involved the construction of a sewer tunnel within a layered silty clay sandwiched between two water-bearing, granular deposits. Local water-bearing depressions in the upper clay layer caused several collapses of the tunnel roof. The groundwater level was subsequently lowered by means of an eductor well system, allowing the completion of the tunnel in relatively dry conditions. The second case involved the sinking of a 21 m deep exploratory mine shaft through water-bearing silts and sands. After three unsuccessful attempts without ground water control, eductor wells were installed around a steel sheet pile cofferdam to permit the successful sinking of the shaft to bedrock. These two case histories illustrate the value of adequate ground water investigations to avoid costly excavation problems. (Purdin-NWWA)
W80-02648

8I. Fisheries Engineering

RANGE OF CHANGES IN FISHPOND ENVIRONMENT INFLUENCED BY INTENSIVE CARP FARMING,
Polish Academy of Sciences, Golysz. Fish Culture Station.
For primary bibliographic entry see Field 5C.
W80-02486

STUDIES ON THE INFLUENCE OF MAN (ANGLING) ON FRESHWATER FISH POPULATIONS IN SOUTHERN POLAND,
Polish Academy of Sciences, Krakow. Inst. of Biology.
For primary bibliographic entry see Field 6G.
W80-02487

EXPLOITATION OF FISHERY RESOURCES IN LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 6G.
W80-02488

ENDOHELMINTHS OF SALMONIDA FROM THE ARTIFICIAL LAKE PIVA, MONTENEGRO, YUGOSLAVIA,
Biological Inst., Titograd (Yugoslavia).
For primary bibliographic entry see Field 5C.
W80-02490

UNIQUE CHARACTERISTICS OF ICHTHYOFAUNA AND ICHTHYOPARASITES OF SKADAR LAKE,
Biological inst., Titograd (Yugoslavia).
For primary bibliographic entry see Field 5C.
W80-02492

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

DIRECTORY OF WATER RESOURCES EXPERTISE.
For primary bibliographic entry see Field 7B.
W80-02411

PUBLICATIONS RELATED TO THE NATIONAL WATER DATA EXCHANGE (NAWDEX)--1971-79,
Geological Survey, Reston, VA. Water Resources Div.
Availability: OFSS, USGS Box 25425 Denver, CO 80225. Microfiche $3.50, Paper copy, $2.25. Geological Survey open-file report 79-1299, 1979. 16 p.
B. M. Myers, compiler.

Descriptors: *Bibliographies, *Publications, *Abstracts, *Data storage and retrieval, Water resources, *National Water Data Exchange(NAWDEX).

The National Water Data Exchange (NAWDEX), formally established in January 1976, is a national confederation of water-oriented organizations working to improve access to water data. Its primary objective is to assist users of water data in the identification, location, and acquistion of useful data. NAWDEX is coordinated by a central Program Office, located within the Water Resources Division of the U.S. Geological Survey, which provides data-exchange policy and guidelines to all participants in the program. In addition to the Program Office, there is a network of Assistance Centers located in 45 States and Puerto Rico which provides direct access to NAWDEX. Membership in NAWDEX is voluntary and open to any water-oriented organization that wishes to participate. This publication contains an alphabetical listing, by author, of the reports that have been produced by the NAWDEX Program Office since 1975, as well as reports from other sources that relate to the development of the NAWDEX program. (Woodard-USGS)
W80-02593

10F. Preparation Of Reviews

MECHANICS OF SEDIMENT TRANSPORTATION AND ALLUVIAL STREAM PROBLEMS,
Roorkee Univ. (India).
For primary bibliographic entry see Field 2J.
W80-02700

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200 MILE ECONOMIC ZONE
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W80-02521 5C

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Impact of Western Coal Mining - II. Microbiological Studies,
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Acid Precipitation: Measurement of pH and Acidity,
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ACIDITY
Acid Precipitation: Measurement of pH and Acidity,
W80-02667 2K

Acidification and Other Chemical Changes in Halifax County Lakes after 21 Years,
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ACTIVATED CARBON
Adsorption of Free and Complexed Metals from Solution by Activated Carbon,
W80-02406 5D

ACTIVATION ENERGY
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Adsorption of Free and Complexed Metals from Solution by Activated Carbon,
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